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CDA3000

Application Manual

Inverter drive system
to 132 kW

Adaptation of the drive system to the application

LUST

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Overview of documentation

Before purchase

CDA3000 Catalogue
Selecting and ordering a drive system

With shipment (depending on supply package)

CDA3000 Operation Manual (D)	Operation Manual KEYPAD KP200 (E)	Application Manual (F1)
Quick and easy initial commissioning	Operation via KEYPAD KP200	Adaptation of the drive system to the application

CAN_{Lust} Communication Module Manual (G1)	CAN_{open} Communication Module Manual (G2)	PROFIBUS-DP Communication Module Manual (G3)
Project planning, installation and commissioning of the CDA3000 on the field bus	Project planning, installation and commissioning of the CDA3000 on the field bus	Project planning, installation and commissioning of the CDA3000 on the field bus

F1

Application Manual CDA3000

ID no.: 0840.22 B.5-00

Date: 12/2005

Valid for software version V3.5 and above

LUST

Dear User,

This manual is aimed primarily at you as a **programmer** of drive and automation solutions. It describes how you can adapt your new CDA3000 drive system optimally to your specific application. We assume that your drive is already running – if not, you should first consult the Operation Manual.

Don't be put off by the size of the manual: Only sections 1 to 3 contain essential information with which you need to familiarize yourself. The remaining sections and the Appendix are provided **as reference resources**: (They demonstrate the full scope of functions and flexibility of the CDA3000's software package in solving a wide variety of drive tasks.) In those sections you can concentrate on the functions relevant to your own application, such as power failure bridging or DC braking.

Good luck, and have a nice day!

How to use this manual

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Pictograms

➢ **Attention!** Misoperation may result in damage to the drive or malfunctions.

➢ **Danger from electrical tension!** Improper behaviour may endanger human life.

➢ **Danger from rotating parts!** The drive may start running automatically.

➢ **Note:** Useful information

➢ **Reference:** More information in other sections of the Application Manual or additional documents

➢ Function not available in the control mode

➢ Function is disabled

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4 Application data sets

5 Software functions

6 Control modes

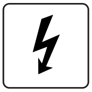
1 Safety

1.1 Measures for your safety

The CDA3000 inverter drives are quick and safe to handle. For your own safety and for the safe functioning of your device, please be sure to observe the following points:

Read the Operation Manual first!

- Follow the safety instructions!

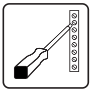


Electric drives are dangerous:

- Electrical voltages > 230 V/400 V: Dangerously high voltages may still be present 10 minutes after the power is cut. So always make sure the system is no longer live!
- Rotating parts
- Hot surfaces

Your qualification:

- In order to prevent personal injury and damage to property, only personnel with electrical engineering qualifications may work on the device.
- The qualified personnel must familiarize themselves with the Operation Manual (refer to IEC364, DIN VDE0100).
- Knowledge of national accident prevention regulations (e.g. VBG 4 in Germany, regulations laid down by the employers' liability insurance associations) is essential.



During installation observe the following instructions:

- Always comply with the connection conditions and technical specifications.
- Comply with the standards for electrical installations, such as regarding wire cross-section, grounding lead and ground connections.
- Do not touch electronic components and contacts (electrostatic discharge may destroy components).

1.2 Intended use

Frequency inverter drives are components that are intended for installation in electrical systems or machines. The drive may not be commissioned (i.e. it may not be put to its intended use) until it has been established that the machine as a unit complies with the provisions of the Machinery Directive (98/37/EC). EN 60204 (Safety of machines) is to be observed.

CE	The CDA3000 conforms to the Low Voltage Directive DIN EN 50178.
EMC	The following generic standards are complied with in application of the installation instructions: • EN 50081-1 and EN 50081-2 (line-borne and radiated interference emission) • IEC 1000-4-2 to 5 / EN61000-4-2 to 5 (Interference immunity of the inverter module) • Product norm EN 61800-3 (Variable-speed drives)

If the frequency inverter is used for special applications (e.g. in areas subject to explosion hazard), the required standards and regulations (e.g. EN 50014, "General provisions" and EN 50018 "Flameproof housing") must always be observed.

Repairs may only be carried out by authorized repair workshops. Unauthorized opening and incorrect intervention could lead to physical injury or material damage. The warranty provided by LUST would thereby be rendered void.

1.3 Responsibility

Electronic devices are fundamentally not fail-safe. The company setting up and/or operating the machine or plant is itself responsible for ensuring that the drive is rendered safe if the device fails.

EN 60204-1/DIN VDE 0113 "Safety of machines", in the section on "Electrical equipment of machines", stipulates safety requirements for electrical controls. They are intended to protect personnel and machinery, and to maintain the function capability of the machine or plant concerned, and must be observed.

An emergency stop system does not necessarily have to cut the power supply to the drive. To protect against danger, it may be more beneficial to maintain individual drives in operation or to initiate specific safety sequences. Execution of the emergency off measure is assessed by means of a risk analysis of the machine or plant, including the electrical equipment to EN 1050, and is determined with selection of the circuit category in accordance with DIN EN 954 "Safety of machines - Safety-related parts of controls".

2 Inverter module CDA3000

This section sets out basic aspects of the device hardware which are essential to understanding and using the Application Manual. For more information on the device hardware refer to the CDA3000 Operation Manual.

2.1 Device and terminal view

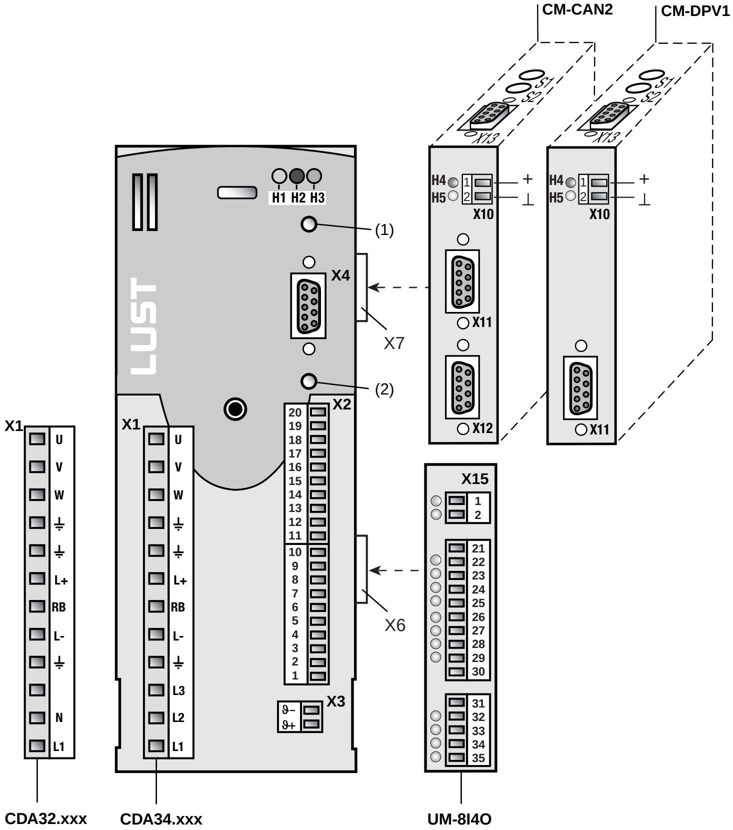


Figure 2.1 Layout, CDA3000

No.	Designation	Function
H1, H2, H3	LEDs	Device status display
X1	Power connection	Mains, motor, to < 22 kW: Braking resistor L+/RB, from > 22 kW: Braking resistor +/RB DC feed (L+/L-)
X2	Control connection	4 digital inputs 3 digital outputs (of which 1 relay) 2 analog inputs 1 analog output

Table 2.1 Key to Figure 2.1

No.	Designation	Function
X3	PTC connection	PTC, thermostatic circuit-breaker or linear temperature transmitter KTY 84-130
X4	RS232 connection	for DRIVEMANAGER or KEYPAD KP200
X6	Option slot 1	e.g. for user module UM8I40
X7	Option slot 2	e.g. for communication module
X10	Voltage supply for communi-cation module	+ 24 V, ground
X11	CAN-In / PROFIBUS-DP	Bus connection input
X12	CAN-Out	CAN bus connection output
X13	Address coding plug	Only for CAN_{open}, Profibus DP
X15	User module UM-8I40	Voltage supply, 8 digital inputs, 4 digital outputs
(1)	Reset button	see section 2.7
(2)	Boot button	see section 2.7
S1, S2	Address coding switch	Only for CAN_{open}, Profibus DP

Table 2.1 Key to Figure 2.1

X1	Designation	X1	Designation
U	Motor cable U	U	Motor cable U
V	Motor cable V	V	Motor cable V
W	Motor cable W	W	Motor cable W
⏚	Grounding lead PE	⏚	Grounding lead PE
⏚	Grounding lead PE	⏚	Grounding lead PE
L+	DC-link voltage +	L+	DC-link voltage +
RB	Braking resistor	RB	Braking resistor
L-	DC-link voltage -	L-	DC-link voltage -
⏚	Grounding lead PE	⏚	Grounding lead PE
	NC	L3	Mains phase L3
N	Neutral conductor	L2	Mains phase L2
L1	Mains phase	L1	Mains phase L1

Table 2.2 Power terminal designation, CDA3000

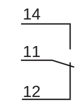
X2	Designation	Function
20	OSD02/14	Changeover relay make contact 
19	OSD02/11	Changeover relay root
18	OSD02/12	Changeover relay break contact
17	DGND	Digital ground
16	OSD01	Digital output
15	OSD00	Digital output
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Digital input
11	ISD02	Digital input
10	ISD01	Digital input
9	ISD00	Digital input
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V DC
6	U_V	Auxiliary voltage 24 V DC
5	OSA00	Analog output
4	AGND	Analog ground
3	ISA01	Analog input
2	ISA00	Analog input
1	U_R	Reference voltage 10 V

Table 2.3 Control terminal designation, CDA3000

X15	Designation	Function
1	U_V	24 V DC supply, feed
2	DGND	Digital ground
21	U_V	Auxiliary voltage 24 V DC
22	IED00	Digital input
23	IED01	Digital input
24	IED02	Digital input
25	IED03	Digital input
26	IED04	Digital input
27	IED05	Digital input
28	IED06	Digital input
29	IED07	Digital input
30	DGND	Digital ground
31	DGND	Digital ground
32	OED00	Digital output
33	OED01	Digital output
34	OED02	Digital output
35	OED03	Digital output

Table 2.4 Control terminal designation, UM-8140

2.2 Module mounting

Inverter modules **up to size BG5** are side mounted. To remove them, press the red release lever on the front and withdraw the module to the side.

As from size BG6 the modules are built-in. This additionally requires **mounting package MP-xxxx** for each module (see order catalogue).

The modules are interconnected with the aid of the mounting package from X6 →X6 and X7 →X7.

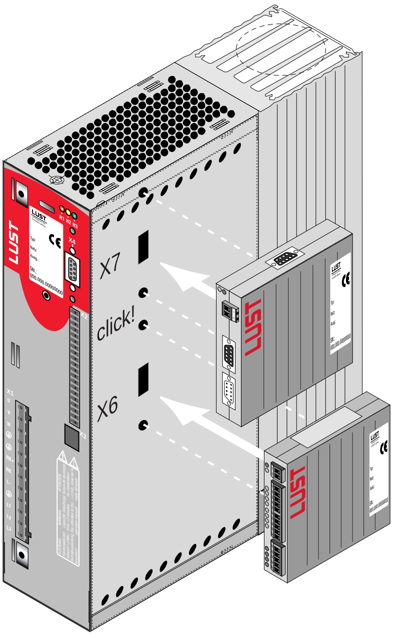
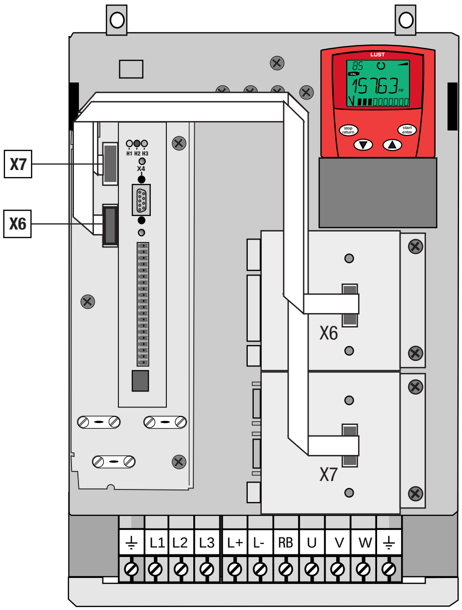
Inverter module BG1 ... BG5	**Inverter module BG6 ... BG8**
	
X6 = option slot 1 for user modules (UM-xxxx) X7 = option slot 2 for communication modules (CM-xxxx).	The CDA3000 inverter modules have two option slots to accommodate user and communication modules.

Figure 2.2 Mounting of user/communication modules

Attention! Do not plug modules in during operation.

2.3 Ambient conditions

Characteristic		Inverter module	User and communication module
Temperature range	in operation	-10 ... 45 °C (BG1 ... BG5) 0 ... 40 °C (BG6 ... BG8) with power reduction to 55 °C	-10 ... 55 °C
	in storage	-25 ... +55 °C	
	in transit	-25 ... +70 °C	
Relative air humidity		15 ... 85 %, condensation not permitted	
Mechanical strength to IEC 68-2-6	in stationary use	Vibration: 0.075 mm in frequency band 10 ... 58 Hz Shock: 9.8 m/s^2 in frequency band >58 ... 500 Hz	
	in transit	Vibration: 3.5 mm in frequency band 5 ... 9 Hz Shock: 9.8 m/s^2 in frequency band >9 ... 500 Hz	
Protection	Device	IP20 (NEMA 1)	
	Cooling method	Cold plate IP20 Push-through heat sink IP54 (3 ... 15 kW) Push-through heat sink IP20 (22 ... 37 kW)	Convection IP20
Touch protection		VBG 4	
Power reduction		see section 5.5.12 "Modulation"	None
Mounting height		Up to 1000 m above MSL, above 1000 m above MSL with power reduction of 1% per 100 m, max. 2000 m above MSL	

Table 2.5 Ambient conditions for the modules

2.4 Specification of control connections

Inverter module CDA3000

Des.	Terminal	Specification	floating
Analog inputs			
ISA00	X2-2	• U_{IN} = +10 V DC, ±10 V DC I_{IN} = (0) 4-20 mA DC, switchable by software to: • 24 V digital input, PLC-compatible • Switching level low/high: <4.8 V / >8 V DC • Resolution 10-bit • R_{IN}=110kΩ • Terminal scan cycle = 1ms • Tolerance: U: ±1% of MV I: ±1% of MV	against digital GND
ISA01	X2-3	• U_{IN} = +10 V DC, software-switchable to: • 24 V digital input, PLC-compatible • Switching level low/high: <4.8 V / >8 V DC • Resolution 10-bit • R_{IN}=110 kΩ • Terminal scan cycle = 1ms • Tolerance: U: ±1% of MV	against digital GND
Analog output			
OSA00	X2-5	• PWM with carrier frequency 19.8 kHz • Resolution 10-bit • f_{limit} = 1.1 kHz • R_{OUT}=100 Ω • U_{out}=+10 V DC • I_{max}=5 mA • Short-circuit-proof • Internal signal delay time ≈ 1ms • Tolerance ±2.5%	✔

Table 2.6 Specification of control connections

Des.	Terminal	Specification	floating
Digital inputs			
ISD00	X2-9	• Limit frequency 5 kHz • PLC-compatible • Switching level low/high: <5 V / >18 V DC, range >5 V to <18 V DC undefined • I_{max} at 24 V = 10 mA • R_{IN} = 3 kΩ • Internal signal delay time ≈ 100µs • Terminal scan cycle = 1ms	✔
ISD01	X2-10	• Limit frequency 150 kHz • PLC-compatible • Switching level low/high: <5 V / >18 V DC, range >5 V to <18 V DC undefined • I_{max} at 24 V = 10 mA • R_{IN} = 3 kΩ • Internal signal delay time ≈ 2µs • Terminal scan cycle = 1ms • Data input with reference coupling (Master/ Slave)	✔
ISD02	X2-11	• Limit frequency 500 kHz • PLC-compatible • Switching level low/high: <5 V / >18 V DC, range >5 V to <18 V DC undefined • I_{max} at 24 V = 10 mA • R_{IN} = 3 kΩ • Internal signal delay time ≈ 2µs • Terminal scan cycle = 1ms • A-input with square encoder evaluation for 24 V HTL encoder against GND_EXT • Permissible pulse count 32...16384 pulses per rev. (2^n with n = 5...14)	✔

Table 2.6 Specification of control connections

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Des.	Terminal	Specification	floating
ISD03	X2-12	• Limit frequency 500 kHz • PLC-compatible • Switching level low/high: <5 V / >18 V DC, range >5 V to <18 V DC undefined • I_{max} at 24 V = 10 mA • R_{IN} = 3 kΩ • Internal signal delay time ≈ 2μs • Terminal scan cycle = 1ms • B-input with square encoder evaluation for 24 V HTL encoder against GND_EXT • Permissible pulse count 32...16384 pulses per rev. (2^n with n = 5...14)	✔
ENPO	X2-8	• Power stage enable = High level • Switching level low/high: <5 V / >18 V DC, range >5 V to <18 V DC undefined • I_{max} at 24 V = 10 mA • R_{IN} = 3 kΩ • Internal signal delay time ≈ 20μs • Terminal scan cycle = 1ms • PLC-compatible	✔
Digital outputs			
OSD00	X2-15	• Short-circuit-proof • PLC-compatible • I_{max} = 50 mA • Internal signal delay time ≈ 250μs • Terminal scan cycle = 1ms • Protection against inductive load • High-side driver	✔
OSD01	X2-16	• Short-circuit-proof with 24 V supply from inverter module • PLC-compatible • I_{max} 50mA • Internal signal delay time ≈ 2μs • Terminal scan cycle = 1ms • No internal freewheeling diode; provide external protection • High-side driver • Data output with reference coupling	✔ [1)
[1) applicable to limited degree			

Table 2.6 Specification of control connections

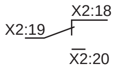
Des.	Terminal	Specification	floating
Relay output			
OSD02	X2-18 X2-19 X2-20	• Relay 48 V / 1 A AC, changeover contact • Usage category AC1 • Operating delay approx. 10 ms 	✔
Motor temperature monitor			
PTC1/2	X3-1 X3-2	• Measuring voltage max. 12 V DC • Measuring range 100 Ω - 15 kΩ • suitable for PTC to DIN 44081/44082 • suitable for temperature sensor KTY84-130 tolerance band yellow • suitable for thermostatic circuit-breaker (Klixon) • Sampling time 5ms	✔
1) applicable to limited degree			
voltage supply			
+10.5 V	X2-1	• Auxiliary voltage U_R =10.5 V DC • Short-circuit-proof • I_{max} = 10 mA	–
+24 V	X2-6 X2-7 X2-13	• External auxiliary voltage: U_V = 24 V DC ±25%, I_{max} = 500 mA • Short-circuit-proof • I_{max} = 200 mA (overall, also includes driver currents for outputs OSD00 and OSD01) • No polarity reversal protection	✔
Analog ground			
AGND	X2-4	• Isolated from DGND	
Digital ground			
DGND	X2-14 X2-17	• Isolated from AGND	

Table 2.6 Specification of control connections

Note: The sampling time of the inputs and outputs is 1 ms. The digital voltages relate to the digital ground and the analog voltages to the analog ground.

Pin assignment of serial interface X4

Pin no.	Function
1	+15 V DC for KEYPAD KP200
2	TxD, send data
3	RxD, receive data
4	NC, free contact
5	GND for +15 V DC of KEYPAD KP200
6	+24 V DC, control pcb power supply
7	NC, free contact
8	NC, free contact
9	GND for +24 V DC, control pcb power supply

Table 2.7 Specification of interface contacts

User module UM-8I4O

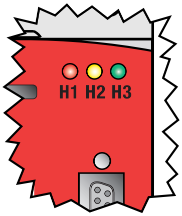
Des.	Terminal	Specification	floating
Digital input			
+24 V DC	X15-21	Supply voltage for IEDxx	
IED00 to IED07	X15-22 to X15-29	• Limit frequency 5 kHz • PLC-compatible • Switching level Low/High: >5 V / >15 V DC • I_{max} at 24 V = 6 mA • R_{IN} = 4 kΩ • Internal signal delay time ≈ 2µs • Terminal scan cycle = 1ms	✔
DGND	X15-30	• Digital ground for IEDxx	

Table 2.8 Specification of control connections, UM-8I4O

Des.	Terminal	Specification	floating
OED00 to OED03	X15-32 to X15-35	• Short-circuit proof, I_{kmax} = 1.2 A/OEDxx • PLC-compatible • Current at "1": I_{min} = 5 mA I_{max} = 500 mA • I_{max} in parallel operation = 125 mA • Internal signal delay time ≈ 250µs • Terminal scan cycle = 1ms • Protection against inductive load • Thermal overload protection • High-side driver	✔
DGND	X15-31	• Digital ground for OEDxx	
Supply voltage, module feed			
+24 V DC	X15-1	• U_V = 24 V DC ±25% • I = 0.6 A • No polarity reversal protection	
DGND	X15-2	• Digital ground	

Table 2.8 Specification of control connections, UM-8I4O

2.5 LEDs



At the top right of the inverter module there are three status LEDs coloured red (H1), yellow (H2) and green (H3).

Device status	Red LED (H1)	Yellow LED (H2)	Green LED (H3)
24 V DC supply voltage for control unit applied (24 V DC internal or external), or controller in "parameter setting" mode	❍	❍	●
Ready (ENPO set)	❍	●	●
In service/Auto-tuning active	❍	✳	●
Warning (in "ready" condition)	❍	●	●
Warning ("in service"/"auto-tuning active")	❍	✳	●
Error	✳ (flash code)	❍	●
❍LED off, ● LED on, ✳ LED flashing			

Table 2.9 Meanings of LEDs

Note: The parameter-setting mode by control unit is not indicated separately.

Flash code of red LED H1	Display KEYPAD	Error cause
1x	E-CPU	Collective error message
2x	E-OFF	Undervoltage shut-off
3x	E-OC	Current overload shut-off
4x	E-OV	Voltage overload shut-off
5x	E-OLM	Motor overloaded
6x	E-OLI	Device overloaded
7x	E-OTM	Motor temperature too high
8x	E-OTI	Cooling temperature too high

Table 2.10 Error messages

Error messages can be viewed in more detail using the KEYPAD KP200 control unit or the DRIVEMANAGER.

2.6 Isolation concept

The analog and digital grounds are isolated from each other in order to avoid transient currents and interference over the connected lines. The analog ground is connected directly to the inverter module processor. It serves as the reference potential for analog reference input. The digital inputs and outputs are isolated from it. Disturbance variables are thereby kept away from the processor and the analog signal processing function. To enhance operating safety we recommend that the analog and digital grounds should not be interconnected.

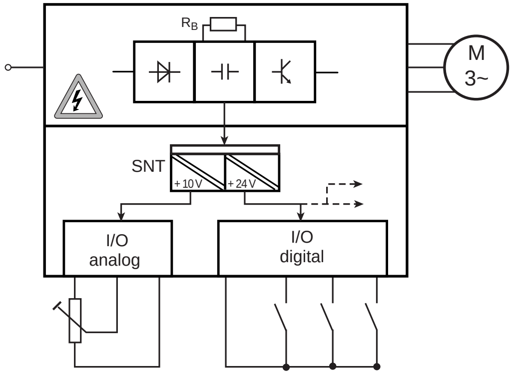


Figure 2.3 Voltage supply to I/Os

When selecting the cable, note that the cables for the analog inputs and outputs must always be shielded. The cable or wire core shield on shielded pairs should cover as large an area as possible in respect of EMC considerations. In this way high-frequency interference voltages are safely discharged (Skin effect). Electromagnetically compatible wiring is essential, and must be provided.

Special case: Use of an analog input as a digital input

Use of the internal 24 V DC as the supply voltage when using an analog input with the "digital input" function requires connection of analog and digital ground. For the reasons mentioned above, this can lead to interference, and demands extra care in selecting and connecting the control cables.

A bridge is only required when the internal 24 V is used.

X2	Function
1	Reference voltage 10 V, 10mA
2	ISA00, as dig. input
3	ISA01, as dig. input
4	Analog ground
5	OSA00
6	Auxiliary voltage 24 V, max. 200 mA
7	
13	Auxiliary voltage 24 V
14	Digital ground
15	
16	
17	Digital ground

Figure 2.4 Removal of isolation when using the analog inputs with the digital function

If more digital inputs and outputs are required than are present on the inverter module, we recommend using user module UM-8I4O. It ensures safe operation of the CDA3000 inverter module with no disturbance of the analog signals. Safe operation based on burst immunity to EN 61000-4-4 is not affected by connection of the analog and digital ground. The only effect may be on evaluation of the analog input resulting from interference voltage where long cables are attached to the digital outputs and inputs.

Example: Risk of disturbance

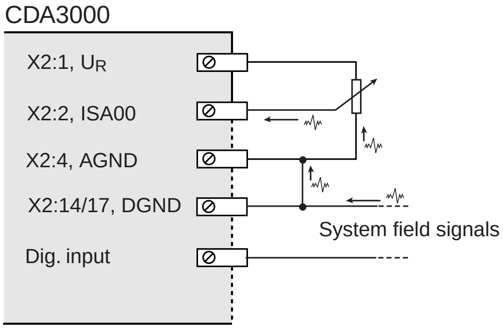


Figure 2.5 Disturbance of the analog input in event of defective wiring

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Note: The analog inputs should be used either both only in analog or both only in digital mode. Combining the analog inputs with one input in analog mode and one in digital mode may result in disturbance of the analog input.

2.7 Reset

Parameter reset

On the KeyPad PARA menu: Press the two cursor keys to reset **the parameter currently being edited** to the factory defaults (152-ASTER = DRV_1).

In the DriveManager: In the edit window of the parameter editor choose the "Default" button.

Factory setting of a data set

By setting parameter 4-PROG = 1 in subject area _86SY- System, the active data set in the RAM is reset to its factory defaults.

Attention! The factory setting causes application data set 1 (traction and lifting drive, DRV_1) to be loaded. Pay attention to the terminal assignment and the functionality of the inverter module in this operation mode.

Finally, the factory setting in the RAM should be saved in a user data set by way of parameter 164-UMWR in subject area "_15FC-Initial commissioning". Caution: Saving the factory setting by way of 150-SAVE = START in subject area "_15FC-Initial commissioning" causes user data set 1 to be overwritten, because it is preset in the factory setting.

Factory setting of all user data sets (complete device in delivery condition)

- DriveManager: By setting parameter 4-PROG = 850 in subject area _86SY-System, the device is reset completely to its factory setting. This includes all user data sets. During this process communication with the DriveManager is cut. Reconnect.
- KeyPad: You can achieve the same effect by simultaneously pressing the two cursor keys on the KeyPad KP200 while the inverter module is powering up. The KeyPad displays "RESET".

The reset takes approx. 30 seconds to restore the factory defaults of all user data sets. Then the device is ready to start again. User data set 1 is in the active data set (RAM).

Attention! The factory setting causes application data set 1 (traction and lifting drive, DRV_1) to be loaded. Pay attention to the terminal assignment and the functionality of the inverter module in this operation mode.

2.8 Loading device software

Loading new device software

With the DRIVEMANAGER a new device software release (firmware) can be loaded into the Flash-EPROM of the CDA3000. This means the software can be updated without opening up the inverter module.

1. To perform the update, connect the DRIVEMANAGER to the inverter module.
2. From the Tools menu choose "Load device software (firmware) ...". The DRIVEMANAGER then guides you through the further work steps. LEDs H2 and H3 are lit steadily during transfer of the firmware. When the transfer is completed successfully, LED H2 goes out provided no ENPO signal is applied.

Device software damaged (Bootstrap)

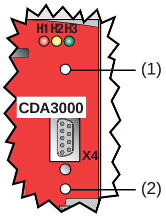
The Bootstrap button is not designed for frequent use, and so should not be pressed unnecessarily.

Note: Do not press the button beyond its contact point, otherwise it may be permanently damaged.

If there is no software in the inverter module or if the connection was broken during downloading of a software program, the following procedure must be followed:

1. The required firmware (Hex file "3_xxx_xx.hex") must be present.
2. Start the firmware transfer. From the DRIVEMANAGER under Tools - "Load device software (firmware) ...".
3. Select device type "CDA3000 (frequency inverter)".
4. Follow the prompt to set the device to Bootstrap mode.

Bootstrap mode on the CDA3000: With the Boot key (2) pressed down, tap the button (1) briefly once. LED H2 goes out, if it was previously lit.



5. The DRIVEMANAGER prepares the device for the firmware transfer and erases the program memory (Flash-EPROM). Then LED H2 lights up in addition to LED H3 and the firmware is transferred.
6. The device reports "Software successfully transferred".

7. A new connection is set up. Message: "Waiting for readiness" from 0...100 %. When the transfer is completed successfully, LED H2 goes out provided no ENPO signal is applied.
8. The CDA3000 automatically cancels Bootstrap mode.

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3 User interface and data structure

The user interface and data structure of the CDA3000 is highly flexible, as a result of various user control variants and wide-ranging parameter-setting facilities. In this way an ordered data structure provides assistance in data handling and in setting the parameters of the CDA3000 inverter module.

A special subject area containing the key parameters for safe operation of the drive provides assistance for quick and easy initial commissioning.

The parameters of the inverter module can be set using the simple KEYPAD KP200 control unit or the user-friendly DRIVEMANAGER PC user software.

DE
EN

3.1 Data structure

For parameter setting, individual parameters, parameter groups in subject areas or complete, predefined parameter data sets can be selected. These preset parameter data sets are termed application data sets (ADS). If the application data sets are modified by adaptations for the customer, the results are user data sets (UDS). Parameters can only be set in the active data set.

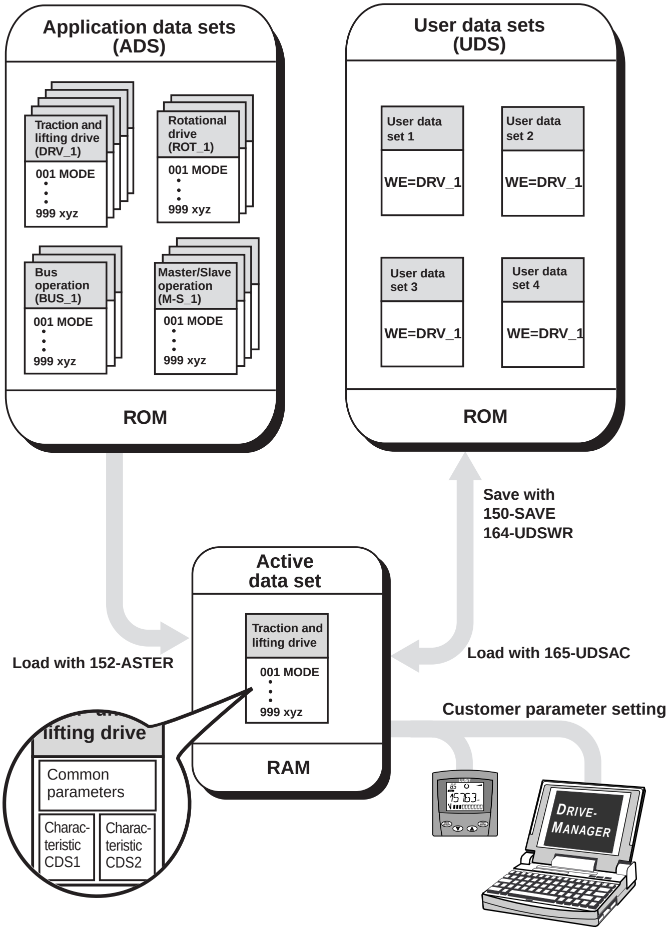


Figure 3.1 Data structure of the CDA3000

Explanatory notes:

- Parameters from subject area "_15FC-Initial commissioning".
- FS = Factory setting

Note: Any change of parameters is made only in the RAM, and at the end must be saved to the ROM by means of parameter 150-SAVE in subject area "_15FC-Initial commissioning".
To save the change, click on the "Save setting in device" button in the DRIVEMANAGER user software. The same effect is achieved by simultaneously pressing the two cursor keys on the KEYPAD KP200 control unit for approx. 2 seconds while at the menu level. At the menu level the display shows "MENU".

Parameters

The parameters are changeable variables which are all assigned a factory setting (FS). They have a fixed value range with a minimum and maximum value. The current parameter value is always displayed.

Subject areas

For ease of handling the parameters are bundled into parameter groups. The parameter groups are termed subject areas, and contain the software functions of the CDA3000 inverter module.

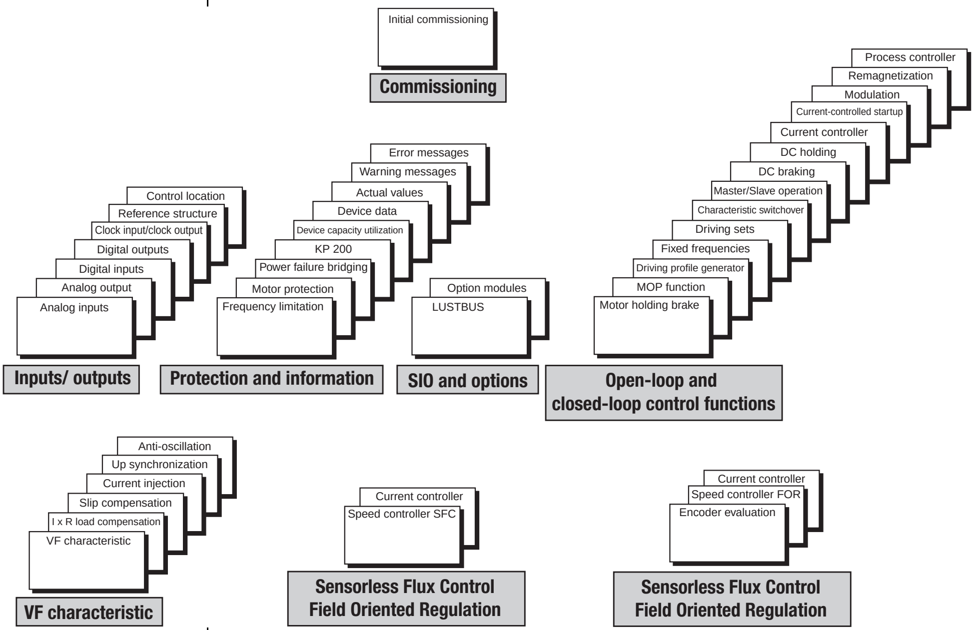


Figure 3.2 Subject areas for function-oriented operation of the inverter module.

3.1.1 Application data sets

Application data sets (ADS) are preset, complete parameter data sets which are provided to handle a wide variety of application-typical movement tasks.

Loading an application data set into the RAM automatically configures the inverter module (see Figure 3.1). All subject areas, including the signal processing inputs and outputs, are preset to the chosen solution.

Using an application data set makes commissioning of the inverter module much quicker and easier. By changing individual parameters, the application data sets can be adapted to the needs of the specific task. These modified application data sets are stored in the device as user data sets. This helps you quickly achieve your desired motion solution.

A total of 15 application data sets cover the typical areas of application of the CDA3000 inverter module.

Application data sets and typical applications:

Application data set	Application
Traction and lifting drive	Conveyor belt, rack, trolley, spindle and lifting gear drives
Rotational drive	Spindle, extruder and Winding drives or centrifuges
Bus operation	Integration of the inverter system in a network via CAN_{Lust}, CAN_{open} or Profibus-DP
Master/Slave operation	Reference coupling of several inverter modules

Table 3.1 Typical uses of the application data sets

Note: The **factory setting (FS)** is application data set 1 of the "traction and lifting drive" category. It is automatically loaded and activated the first time the unit is started. After every subsequent start the selected user data set is loaded.

3.1.2 User data sets

When the application data set has been adapted to the respective application, the resultant new data set must be saved as a custom setting in the user data set. It is not possible to store the data in a factory predefined application data set (see Figure 3.1).

Four user data sets (UDS) can be managed in the inverter module, with one user data set containing two subordinate characteristic data sets (CDS).

The user data sets managed by the inverter can be selected and activated via the KEYPAD, DRIVEMANAGER, by bus access or via terminals. Online switching (drive started) between the user data sets is not possible.

For a user data set switchover the "ENPO" signal can remain set but the power stage of the inverter module must be inactive, i.e. no start signal must be applied. The switchover takes approximately 2 to 3 seconds. The "completed" signal for the switchover can be delivered to a digital output.

Note: It is not possible to switch user data sets online.

Example of switchover via terminals:

Terminal 1	Terminal 2	User data set
0	0	⇨ User data set 1: 001 MODE … 999 xyz
1	0	⇨ User data set 2: 001 MODE … 999 xyz
0	1	⇨ User data set 3: 001 MODE … 999 xyz
1	1	⇨ User data set 4: 001 MODE … 999 xyz

Table 3.2 Example of selection of user data sets via terminals

3.1.3 Characteristic data sets

Each user data set and the application data sets may contain a second characteristic data set. The switch can be made to this second characteristic data set

- by terminals
- when a frequency limit is reached
- when the direction is reversed or
- by bus access.

Note: Online switching between characteristic data sets CDS1 and CDS2 **is possible**.

The following subject areas contain parameters for the second characteristic data set:

Subject area	Parameter
Reference structure	Min., max. and fixed frequency
Driving profile generator	Ramps
Current-controlled startup	All parameters
V/F characteristic	All parameters
IxR load compensation	All parameters
Slip compensation	All parameters
Current injection	All parameters
Magnetization	All parameters
Speed controller SFC	All parameters
Speed controller FOR	All parameters
Analog inputs	Scaling
Process controller	Controller parameters

Table 3.3 Characteristic data set dependent parameters

3.2 User levels in the parameter structure

By means of the parameters the inverter module can be fully adapted to the application task. In addition there are parameters for the internal variables of the inverter module which, for the sake of general operating safety, are protected against user access.

The user levels are set by way of parameter 01-MODE in subject area "_36KP-KEYPAD". The number of editable and displayable parameters changes depending on the user level. The higher the user level the greater the number of accessible parameters. In contrast, users are presented with a more concise range of those parameters which are really required, allowing them to find their specific solution more rapidly. Consequently, choosing as low a user level as possible makes operation significantly easier.

Note: The user levels protect against unauthorized access. Consequently, in parameter setting with the KP200 user level 01-MODE=2 is activated approximately 10 minutes after the last key press.

Whether a parameter can be only viewed, or viewed and edited, on the current user level is indicated by symbols.

in DRIVEMANAGER	in KEYPAD	Description
	-S-	Parameter display only (shown)
	-E-	Parameter editable (edit)
	-E- (flashing)	Parameter being edited (edit)

Table 3.4 Indication of whether a parameter is editable

Error ATT1

If a user attempts to edit a display-only parameter in the KEYPAD, access is denied and a warning message ATT1 is displayed. The warning message can be reset by pressing the **Start/Enter** key.

More user error and fault messages are detailed in the Appendix.

Changing user level

If a higher user level is selected by way of parameter 01-MODE, a prompt for the associated password is automatically delivered. The password can be changed by way of a password parameter in subject area "_36KP-KEYPAD" (setting "000" = password disabled).

Target group	Password parameters	Comments	User level 01-MODE	Password in FS 1)
Layman	No parameter	No access permission, for status monitoring only • No parameter setting • Display of basic parameters	1	-
Beginner	362-PSW2	With basic knowledge for minimal operation • Expanded basic parameters editable • Expanded parameter display	2	000
Advanced	363-PSW3	For commissioning and field bus connection • Parameter setting for standard applications • Expanded parameter display	3	000
Expert	364-PSW4	With control engineering skills • All control parameters editable • Expanded parameter display	4	000
Other	365-PSW5	For system integrators	5	-
Specialist personnel	367-PSWCT	For operation and commissioning by KEYPAD KP 200	CTRL menu	573

1) FS = Factory setting

Table 3.5 Setting user levels via subject area "_36KP-KEYPAD"

If a password is set for user level 2 ... 4, viewing and parameter editing at the relevant user level via KP200 is retained until the switch is made to a lower user level. For this, a new user level must be selected via parameter 01-MODE.

Changing the password for a user level

A password can only be changed for the authorized levels - passwords to a higher user level cannot be viewed or changed. The password is changed by selecting the parameter, editing it and then saving it by pressing the Enter key on the KEYPAD KP 200. It can also be changed by way of the DRIVEMANAGER. The password is not activated until you switch to a lower user level.

Note: Please make a note of any change of password and keep your passwords safe from third parties.

3.3 Operation with KEYPAD KP200

Mounting and connection of the KEYPAD

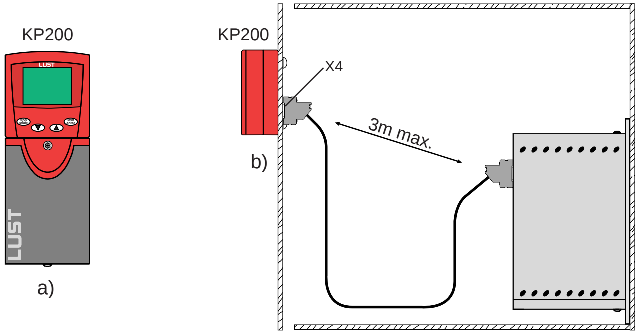
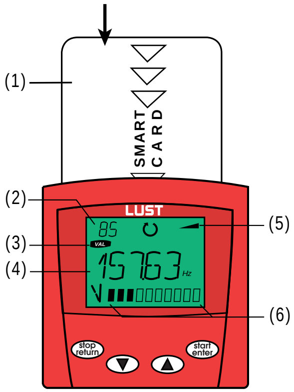


Figure 3.3 Mounting of the KEYPAD: a) on the CDA3000 inverter module (connector X4) or b) on the switch cabinet door

Controls and displays



(1) SMARTCARD chipcard to save and transfer settings

(2) 3-digit display, e.g. for parameter number,

(3) Current menu

(4) 5-digit display for parameter name and value

(5) Acceleration or braking ramp active

(6) Bar graph display, 10-character

Call up menu branches or parameter; Save changes; Start in "Control drive" mode

Quit menu branches; Cancel changes; Stop in "Control drive" mode


Select menu, subject area or parameter; Increase setting


Select menu, subject area or parameter; Reduce setting

Figure 3.4 Operating and display elements of the KEYPAD KP200

Menu structure

The KeyPad KP200 has a user-friendly menu structure which is identical to that of the KP100 for the SmartDrive VF1000 inverters and the MasterControl servocontrollers.

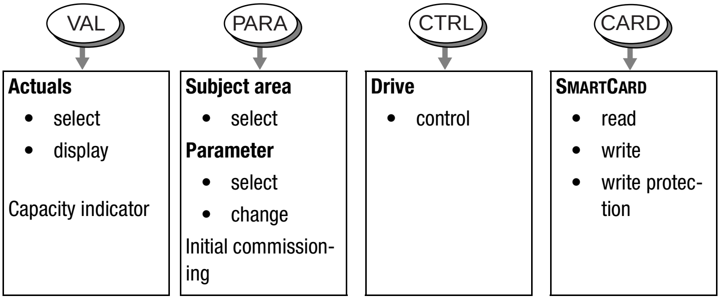


Figure 3.5 Functions of the menus

On the menu level ("MENU" display) you can use the cursor keys to switch between menus. Press the **Start/Enter** key to open a menu and the **Stop/Return** key to quit the menu.

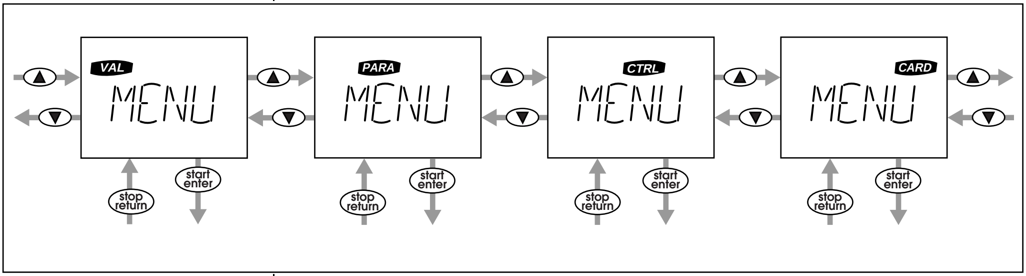
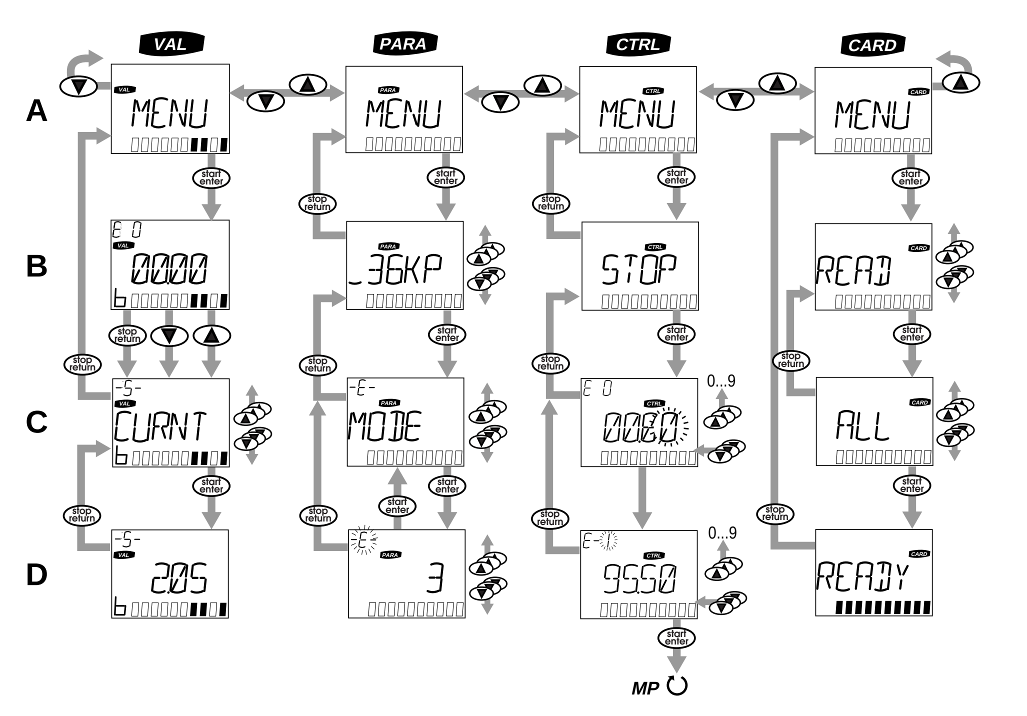


Figure 3.6 Navigation at menu level

Note: Any change of parameters in the "PARA" menu branch is made only in the RAM, and at the end must be saved to the ROM. At the menu level, this is done by simultaneously pressing the two cursor keys for approx. 2 seconds.



A	Select VAL menu (display actuals)	Select PARA menu (parameter setting)	Select CTRL menu (control drive via KEYPAD)	Select CARD menu ((load/save with SMARTCARD)
B	Display continuous actual value, use cursor key to switch to ...	Select subject area	Drive stopped (where appropriate password prompt with display PASSW, factory setting = no password)	READ = load SMARTCARD WRITE = save to SC LOCK = + write protection UNLOCK = - write protection
C	Next actual value	Select parameter	Enter reference	Select parameter area, start with Start/Enter key
D	Display actual value	Display parameter value and change as necessary	Start drive with **Start/Enter**, use cursor keys to change reference value (MP = MOP function)	Function terminated without error

Table 3.6 Menu structure of the KEYPAD KP200 at a glance

For more information on operation with the KEYPAD refer to the KEYPAD KP200 Operation Manual.

Exponential value display

The five-digit parameter value display is in exponential format. The reference input in the CTRL menu is likewise entered and displayed in exponential format.

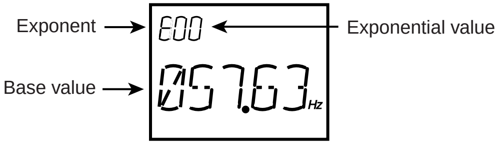


Figure 3.7 Exponential representation on the KP200 display

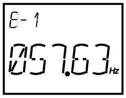
The exponential format is easy to work with if you view the exponential value as a "decimal point shift factor".

Exponential value	Direction of decimal point shift in base value
Positive	To right ⇒ Value increases
Negative	To left ⇒ Value decreases

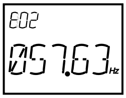
Table 3.7 Exponential value as "decimal point shift factor"

The decimal point is shifted in the base value by the number of places according to the exponential value.

Example:



Decimal point shifted by one place to the left
⇒ 57.63^{-1} Hz = 5.763 Hz



Decimal point shifted by two places to the right
⇒ 57.63^{2} Hz = 5763 Hz

Firmware	Display of parameter values	
Up to V. 3.2	Only exponential view	
From V. 3.3	PARA menu:	The figures are represented with a 0 in the exponent, provided no data loss results.
	VAL menu:	The figures are always represented with a 0 in the exponent, even if a loss of accuracy results.

Table 3.8 Exponential representation on KP200 depending on firmware version

SMARTCARDS

SMARTCARDS are created depending on the firmware of the CDA3000 drive controller. When the firmware is upgraded in line with a new version of the device software, the upgrade is automatically imported into the SMARTCARD when saving ("WRITE").
SMARTCARDS are therefore always upwardly compatible.

Note: SMARTCARDS created with a firmware ≥V.3.00 cannot be imported into devices with firmware >V.3.00. This requires a SMARTCARD created with firmware version V.2.15.

3.4 Operation with DRIVEMANAGER

Connection and startup

The quick route to a drive solution

- Connect the interface cable and switch on the power supply to the drive unit.
- When the program starts the DRIVEMANAGER automatically connects to the attached drive unit (at least V2.3).
- If the connection setup does not occur automatically, check the settings in the **Tools > Options** menu and start the connection setup with the  icon.

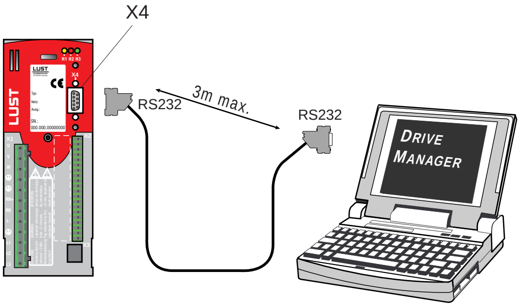
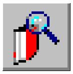
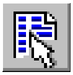
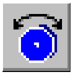
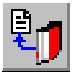
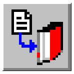
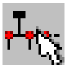
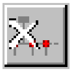


Figure 3.8 Connection via RS232 interface cable (9-pin, plug-and-socket)

The key functions

For more information refer to the DRIVEMANAGER Operation Manual

Icon	Function	Menu
	Connect to device	Communication > Connect > Single device
	Change device settings	Active device > Change settings
	Print parameter data set	Active device > Print settings
	Control drive	Active device > Open-loop control > Basic operation modes, no position references
	Digital scope	Active device > Monitoring > Quickly changing digital scope values
	Save settings from device to file	Active device > Save device settings to

Icon	Function	Menu
	Load settings from file into device	Active device > Load device settings from
	Bus initialization (change settings)	Communication > Bus configuration
	Disconnect from device	Communication > Disconnect
	Compare device settings	Active device > Compare settings

Note: For more information refer to the DRIVEMANAGER Operation Manual.

3.4.1 User screens

DRIVEMANAGER Quick access to CDA3000 setup window or from the menu: Active device > Change settings

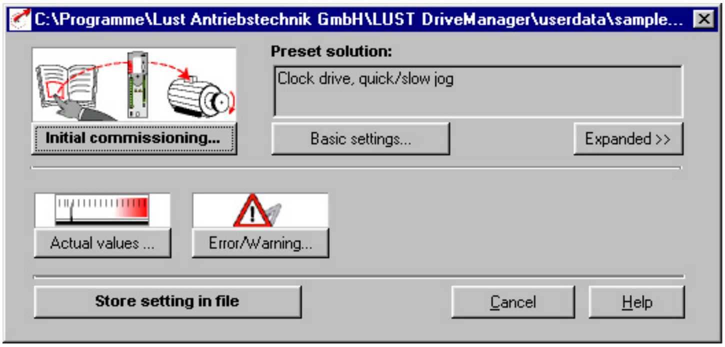


Figure 3.1 CDA3000 setup in minimized view

On the "CDA3000 setup" screen the frequency inverter parameters can be set.

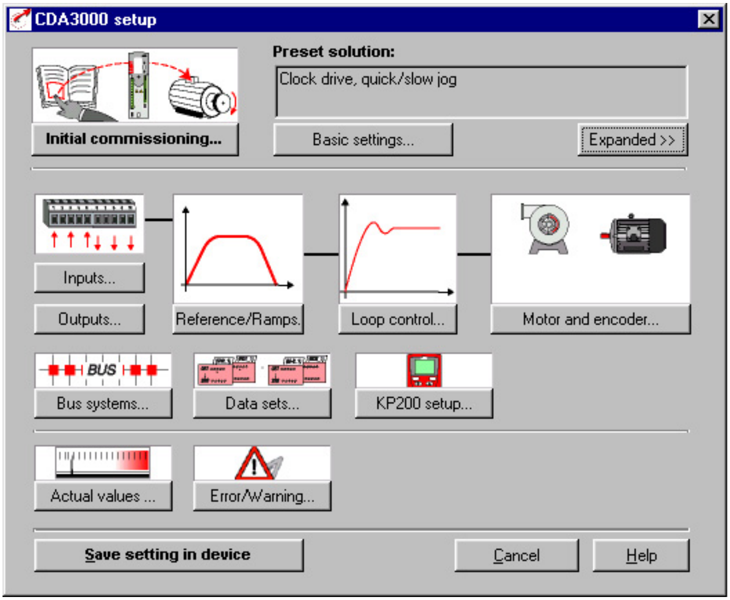


Figure 3.2 CDA3000 setup in expanded view

Note: The settings for the various **preset solutions** are described in **section 4**.
The setting options offered by the **software functions** (inputs/ outputs, loop control, etc.) are described **in section 5**.

Note: Any changes to the parameters are effected only in the volatile memory, and must be saved subsequently in the device by way of the **"Save setting in device"** button. The same effect is achieved by simultaneously pressing the two cursor keys on the KP200 control unit for approx. two seconds while at the menu level (see section 3.3).

Screen operation

For example:

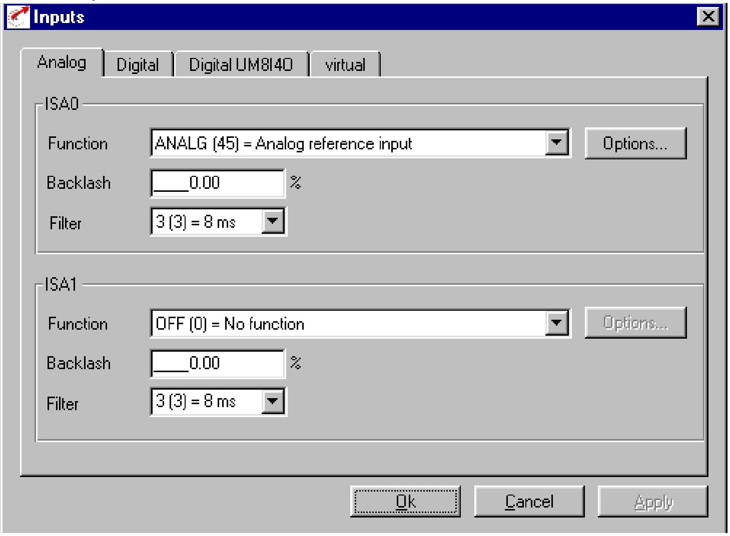


Figure 3.3 Example of screen operation

Functions of buttons:

→ Apply change and close screen

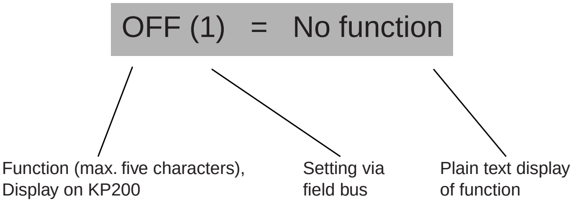
→ Reject change and close screen

→ Apply change (activate) and leave screen open.

→ Optional settings for the relevant function

Explanation of setting

For example:



Help function

In any input dialog box a Help function providing further information on the parameter can be called up by pressing the F1 key.

e.g. function selector screen, analog default input

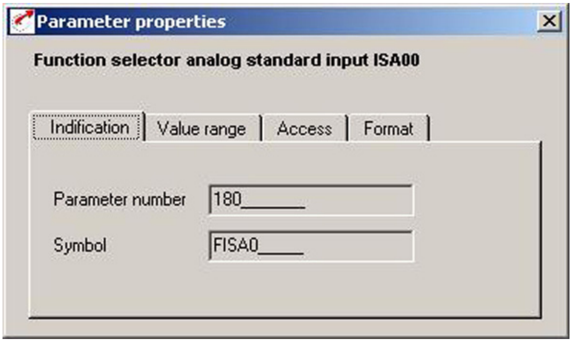


Figure 3.4 Identifier

Parameter number:	Number of parameter
Abbreviation:	Name, max. five characters (displayed in KP200)

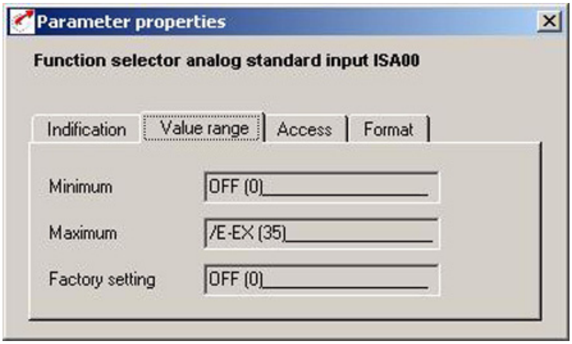


Figure 3.5 Value range

Minimum/Maximum:	The value must be within this range (here: between OFF and /E-EX).
Factory setting:	After a device reset to the factory setting (FS) this value is automatically entered.

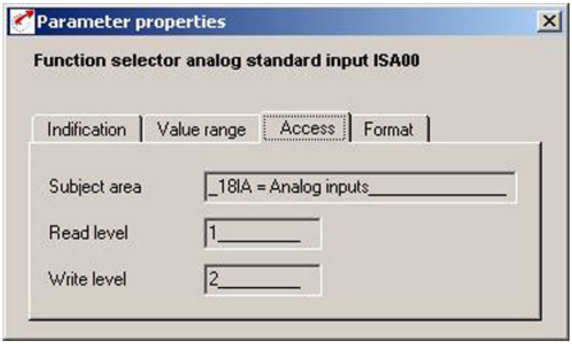


Figure 3.6 Access

Subject area:	For ease of handling the individual parameters are grouped into subject areas.
Read level:	At this level or above the parameter can be read.
Write level:	At this level or above the parameter can be edited.

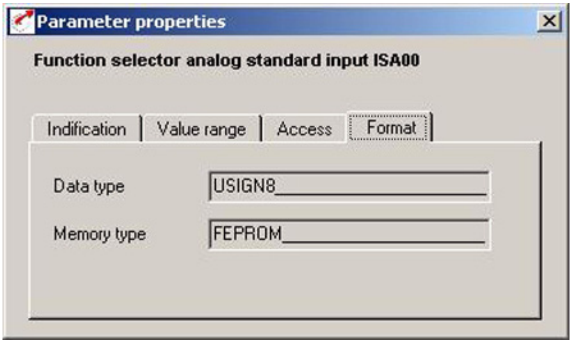


Figure 3.7 Format

For more information on the data and memory types, refer to Appendix A.

3.4.2 Parameter Editor

Parameter Editor

The Parameter Editor contains all the parameters of the device, divided into subject areas, as on the KP200 control unit. The reason for this is to provide experienced users with access to all the parameters of the device (depending on their user level). Note that changes to individual parameters may possibly not be supported by the preset solution.

Subject areas

For ease of handling the individual parameters are grouped into subject areas (parameter groups).

Parameter

The parameters are changeable variables which are all assigned a factory setting (FS). They have a fixed value range with a minimum and maximum value. The current parameter value is always displayed.

Menu: Tools –Parameter Editor

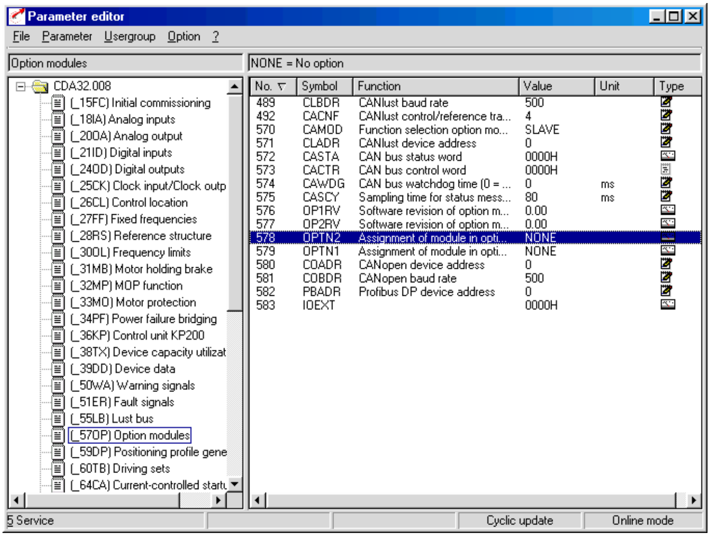


Figure 3.8 Parameter Editor

Note: Full use and parameterization of modified software is possible only with the Parameter Editor.

3.5 Commissioning

Procedure for commissioning with the aid of the Application Manual

1. Initial commissioning based on Operation Manual:

The precondition is initial commissioning with the aid of the Operation Manual.
The user manual only covers adaptation of the software functions.

If the settings from the initial commissioning based on the Operation Manual are not adequate for your application:

2. Selection of the optimum application data set

The application data sets record the typical applications of the CDA3000 inverter module.

See table with overview of application data sets (see section 4.2, "Selection of application data set").

The application data set which best covers the specific application is selected.

3. Custom adaptation of the application data set to the application

The application data sets serve as the starting point for application-oriented adaptation. Other function adaptations are made to the parameters in the function-oriented subject areas (see Figure 3.2 in section 3.1 "Data structure").
Save your settings in the device.

4. Checking the set application solution

To preserve the safety of personnel and machinery, the application solution should only be checked at low speed. Make sure the direction of rotation is correct. In case of emergency the inverter power stage can be disabled, and the drive stopped, by removing the ENPO signal.

5. Concluding commissioning

When you have successfully completed commissioning, save your settings (using the SMARTCARD or DRIVEMANAGER) and store the data set in the device.

Note: As from DRIVEMANAGER V3.0 the parameters are set by way of graphical menus which guide you through the commissioning process.

4 Application data sets

The inverter module contains **preset solutions** for the most frequent applications (so-called "application data sets"). The object of these pre-sets is to find the optimum device setup for the application with minimal parameter setting.

Based on the application-specific basic settings for the "traction and lifting drive" and "rotational drive" categories, all software functions relevant here are already optimized to those applications.
With additional basic settings the inverter module can be very easily be preset for field bus operation or for network operation with several inverter modules (Master/Slave operation).

Within these four presets, the inverter module offers users the possibility of selecting various control terminal settings. In this way the inputs and outputs of the inverter module are adapted to the signals required in the process.

With the total of 20 available presets the inverter module can be adapted with a small number of parameters to virtually any application, thereby greatly reducing commissioning times.

4.1 Activating an application data set

By means of assistance parameter 152-ASTER, in subject area "_15FC-Initial commissioning", a preset application data set is activated in the inverter module. This means that the presets for the application in question are loaded.

Parameter 151-ASTPR, in subject area "_15FC-Initial commissioning", always retains the original device preset as its display value when an application data set is edited.

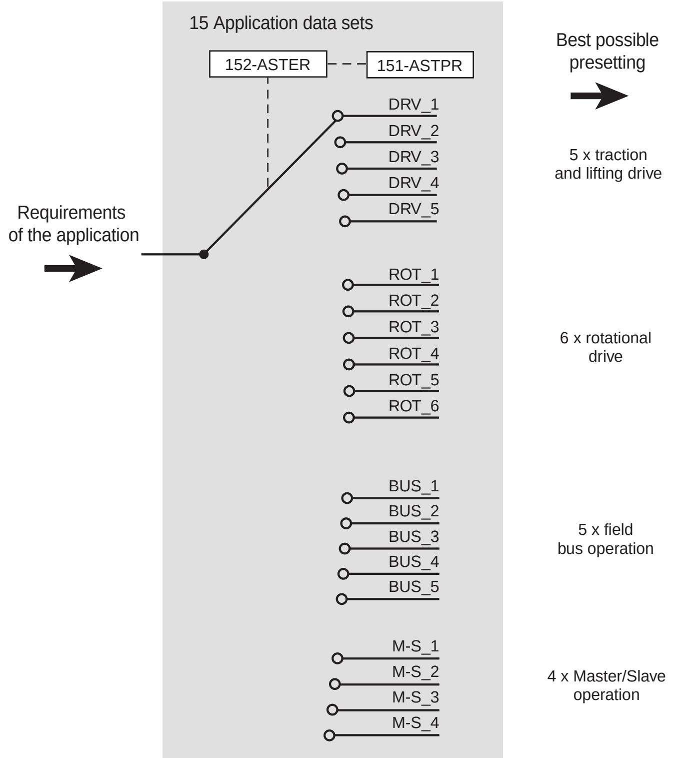


Figure 4.1 *Activating a preset with assistance parameter 152-ASTER* in subject area "_15FC-Initial commissioning"

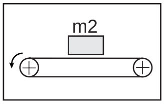
4.2 Selection of application data set

Application data set: traction and lifting drive (activated by 152-ASTER = DRV_x)

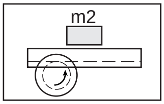
Traction and lifting drive

DRIVE

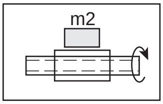
Conveyor belt



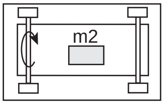
Rack drive



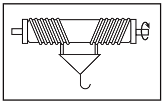
Spindle drive



Trolley drive



Lifting drive



DRV_1	• Quick jog/slow jog driving profile • Process messages
DRV_2	• Quick jog/slow jog driving profile • Characteristic data set switchover • User data set switchover • Process messages
DRV_3	• Quick jog/slow jog driving profile • User data set switchover • Limit switch evaluation • Process messages
DRV_4	• Time-optimized driving profile (fixed frequency) • User data set switchover • Encoder evaluation • Process messages
DRV_5	• Time-optimized driving profile • Table sets for fixed frequencies • User data set switchover • Encoder evaluation • Limit switch evaluation • Process and warning messages

Table 4.1 Area of application: Traction and lifting drive

Note: Application data set DRV_5 requires user module UM-8I40 at option slot 1 (terminal X6).

Application data set: Rotational drive (activated by 152-ASTER = ROT_x)

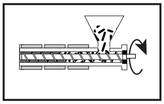
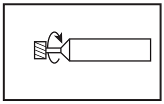
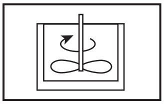
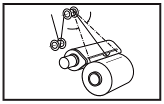
Rotational drive	ROTATION	ROT_1	• Analog speed input • Speed adjustment via button (MOP function) • Process messages
	Extruder 	ROT_2	• Analog speed input • Analog speed correction • Encoder evaluation • Process message
	Spindle drive 	ROT_3	• Analog speed input • Analog speed correction • Table sets for fixed frequencies • User data set switchover • Encoder evaluation • Process and warning messages
	Stirrer 	ROT_4	• Analog speed input • Analog speed correction • Fixed frequencies • Process messages • Process controllers
		ROT_5	• Analog actual value recording • Analog speed reference input • Process messages • Characteristic data set switchover
	Winding drive 	ROT_6	• Functionality of VF1000 • Analog speed input • Fixed frequencies • Process messages • Uniform acceleration and deceleration ramps

Table 4.2 Area of application: Rotational drive

Note: Application data set ROT_3 requires user module UM-8I40 at option slot 1 (terminal X6).

Application data set: Field bus operation (activated by 152-ASTER = BUS_x)

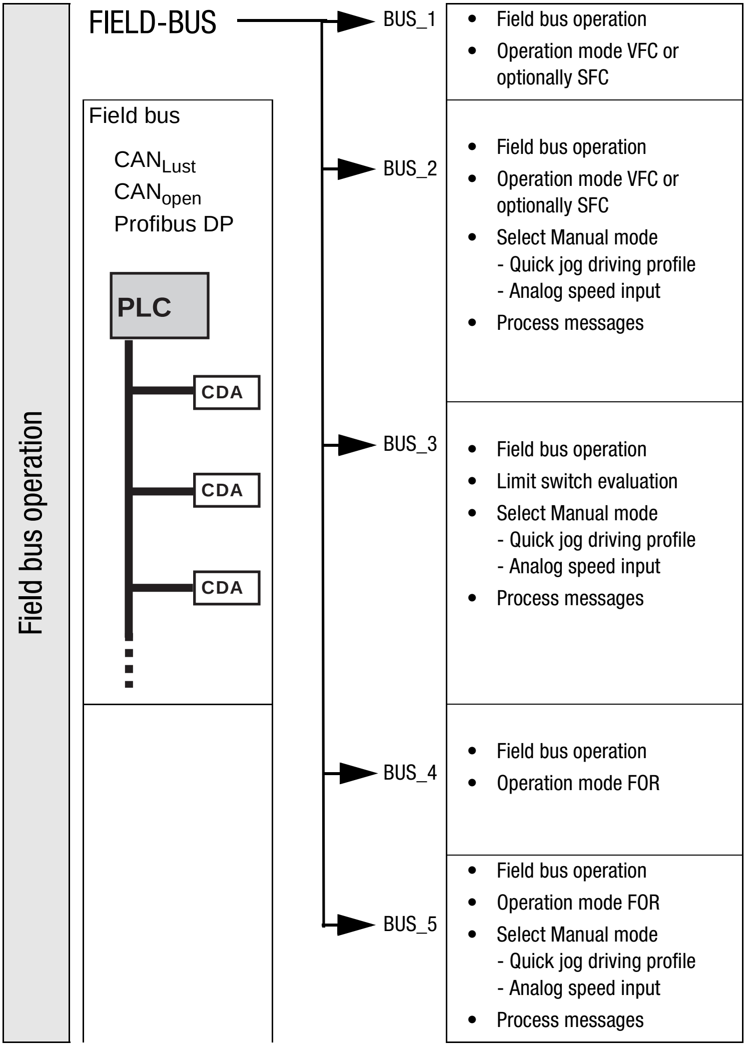


Table 4.3 Area of application: Field bus operation

Note: The "field bus operation" application requires the appropriate communication module at option slot 2 (terminal X7).

Application data set: Master/Slave operation (activated by 152-ASTER = M-S_x)

Master/Slave operation	MASTER-SLAVE	Functions
	M-S_1	• Master • Digital guide value input • Adjustment of guide value via button (MOP function) • Analog speed input • Process messages • Process messages
	M-S_2	• Master • Digital guide value input • Analog speed input • Encoder evaluation • Process messages
	M-S_3	• Slave • Digital guide value recording • Adjustment of guide value via button (MOP function) • Process messages
	M-S_4	• Slave • Digital guide value recording • Encoder evaluation • Process messages

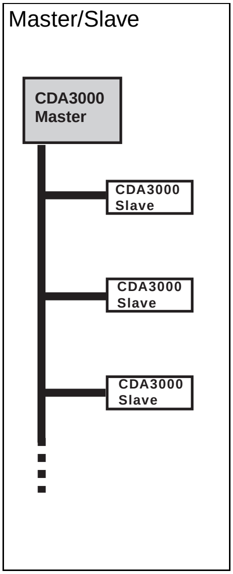


Table 4.4 Area of application: Master/Slave operation

4.3 Traction and lifting drive

Loading one of the application data sets DRV_1 to DRV_5 into the RAM by setting parameter 152-ASTER, in subject area "_15FC-Initial commissioning", causes the inverter module automatically to adopt the preset software functions as well as the presets for all the inputs and outputs for the traction and lifting drive application area.

Active functions in the preset

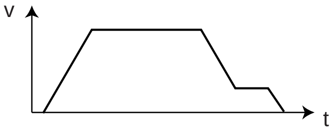
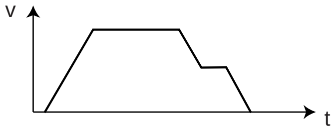
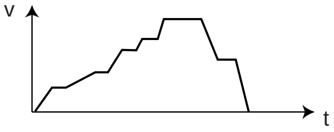
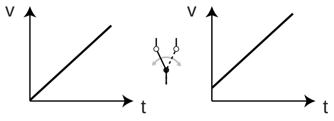
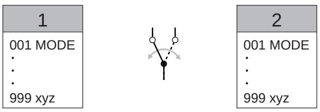
Function		152-ASTER =				
		DRV_1	DRV_2	DRV_3	DRV_4	DRV_5
	Quick jog driving profile	✔	✔	✔	✔	✔
	Quick jog/slow jog driving profile	✔	✔	✔		✔
	Table sets with fixed frequencies and ramps					✔
	Characteristic data switchover		✔			
	User data set switchover		✔	✔	✔	✔

Table 4.5 Traction and lifting drive presets

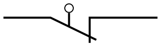
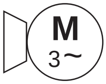
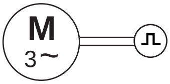
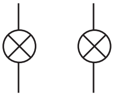
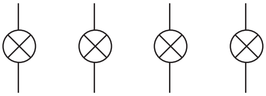
Function	152-ASTER =				
	DRV_1	DRV_2	DRV_3	DRV_4	DRV_5
 Limit switch evaluation			✔		✔
 Motor brake actuation	✔	✔	✔	✔	✔
 Encoder evaluation (necessary for control mode FOR)				✔	✔
 Messages: • Ready to start • Speed reached	✔	✔	✔	✔	✔
 Warnings: • Inverter module overloaded • 80% of IN reached • Motor overloaded • Inverter ambient temperature too high					✔

Table 4.5 Traction and lifting drive presets

Aster	Summary description	Page reference
DRV_1	"Quick jog/slow jog driving profile"	Page 4-10
DRV_2	"Quick jog/slow jog driving profile with switchover"	Page 4-12
DRV_3	"Quick jog/slow jog driving profile with limit switch evaluation"	Page 4-15
DRV_4	"Clock drive with fixed frequency and encoder evaluation"	Page 4-19
DRV_5	"Clock drive with fixed frequencies, encoder and limit switch evaluation"	Page 4-22

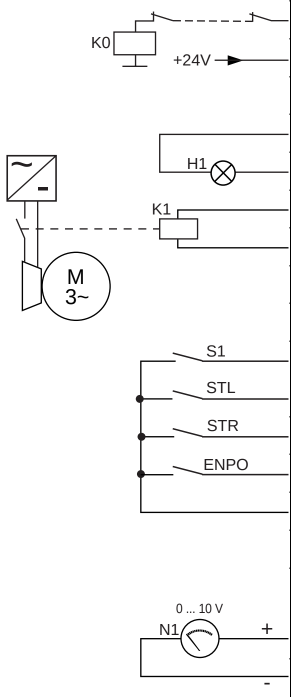
Table 4.6 Page reference to summary description of DRV_x

4.3.1 DRV_1

Quick jog/slow jog driving profile

Preset 1 for traction and lifting drives

Function	Application
• Clock drive with time-optimized quick jog driving profile or • Quick jog/slow jog driving profile • Motor holding brake actuation BRK_1	• Conveyor belt • Trolley drive • Rack drive • Spindle drive etc.

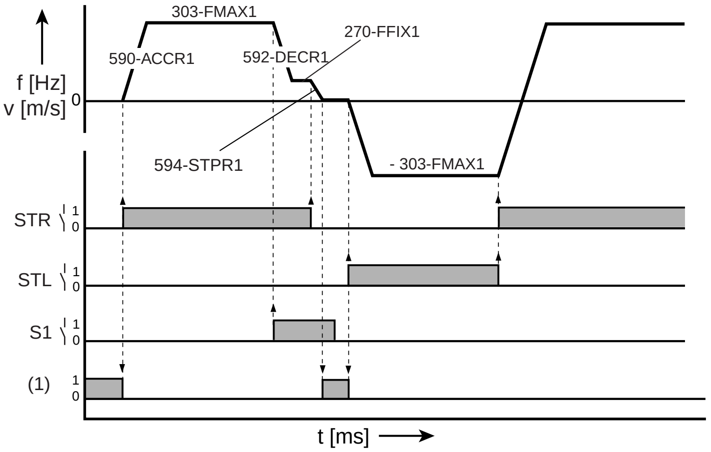


X2	Des.	Function
20	OSD02/14	14 — Relay contact for "Ready" message
19	OSD02/11	11 — Relay contact for "Ready" message
18	OSD02/12	12 — Relay contact for "Ready" message
17	DGND	Digital ground
16	OSD01	"Reference reached" message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Not assigned
11	ISD02	Selection of slow jog
10	ISD01	Start/Stop quick jog anti-clockwise
9	ISD00	Start/Stop quick jog clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX 0 ... 10 V corresponds to 0 ... FMAX
4	AGND	Analog ground 0 ... 10 V corresponds to 0 ... FMAX
3	ISA01	Not assigned
2	ISA00	Not assigned
1	U_R	Reference voltage 10 V, 10 mA

Figure 4.2 Control terminal assignment with ASTER = DRV_1

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 "Comparison of parameters, traction and lifting drive".

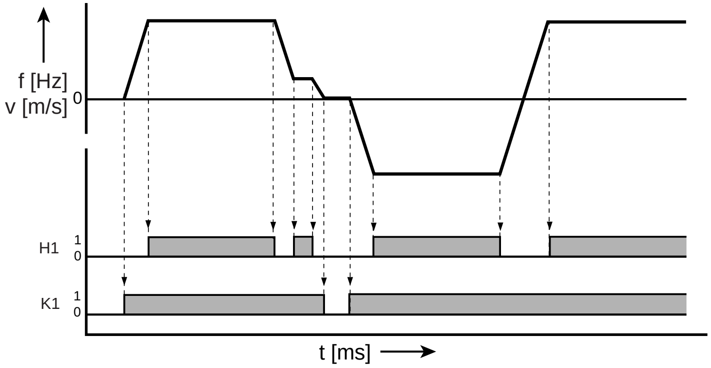
Input signals



(1) DC braking torque, subject area _68HO

Figure 4.3 Example of a quick jog/slow jog driving profile for two directions of rotation (ASTER = DRV_1)

Output signals



H1 Speed reached
K1 Motor holding brake

Figure 4.4 Output signals dependent on driving profile (ASTER = DRV_1 to DRV_5)

4.3.2 DRV_2

Quick jog/slow jog driving profile with switchover

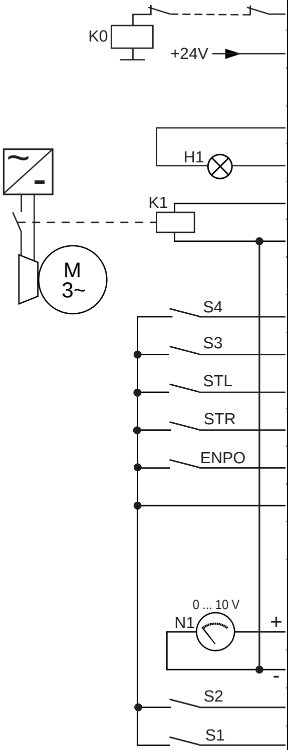
Preset 2 for traction and lifting drives

Function

- Clock drive with time-optimized quick jog driving profile or
- Quick jog/slow jog driving profile
- Application switchover
- Switchover of setting when load changed
- Motor holding brake actuation BRK_1

Application

- Conveyor belt
- Trolley drive
- Rack drive
- Spindle drive
- Lifting drive etc.



X2	Des.	Function
20	OSD02/14	14 / 11 / 12: Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	"Reference reached" message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Characteristic data set switchover
11	ISD02	Selection of slow jog
10	ISD01	Start/Stop quick jog anti-clockwise
9	ISD00	Start/Stop quick jog clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX 0 ... 10 V corresponds to 0 ... FMAX
4	AGND	Analog ground
3	ISA01	User data set switchover
2	ISA00	User data set switchover
1	U_R	Reference voltage 10 V, 10 mA

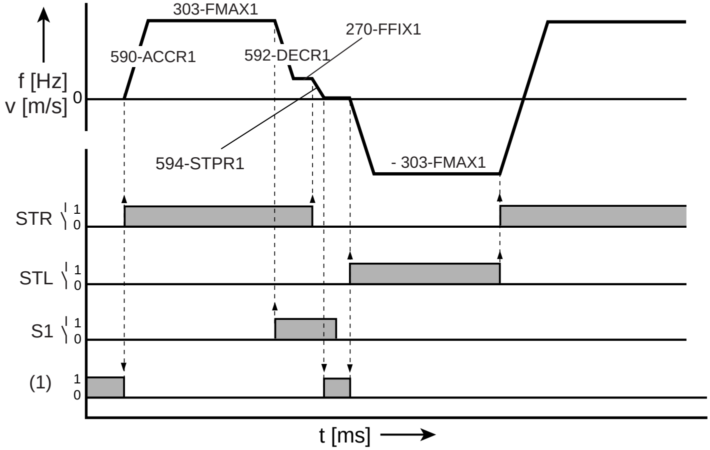
Figure 4.5 Control terminal assignment with ASTER = DRV_2

Note: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD, DRIVEMANAGER) to TERM (terminal operation) and save (see section 5.1 "_15FC-Initial commissioning").

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 "Comparison of parameters, traction and lifting drive".

When interconnecting analog and digital ground, refer to the notes in section 2.6 "Isolation concept". Electromagnetically compatible wiring is essential, and must be provided.

Input signals



(1) DC braking torque, subject area _68HO

Figure 4.6 Example of use of the control terminal presetting with ASTER = DRV_2

The output signals are shown in section 4.3.1 "DRV_1", Figure 4.4.

User data set switchover (switchable offline)

S1	S2	Active UDS	Example
0	0	UDS 1 for application 1	x-axis, traction drive
1	0	UDS 2 for application 2	y-axis, traction drive
0	1	UDS 3 for application 3	z-axis, lifting drive
1	1	UDS 4 for application 4	Sorting belt

Table 4.7 User data set switchover

Characteristic data set switchover (switchable online)

S4	Active characteristic data set	Example
0	Characteristic data set 1	Lifting drive with load
1	Characteristic data set 2	Lifting drive without load

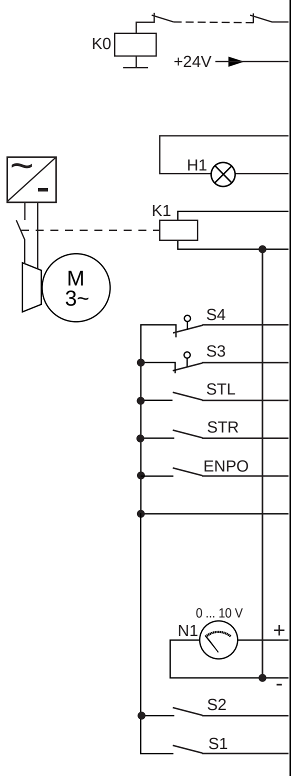
Table 4.8 Characteristic data set switchover

4.3.3 DRV_3

Quick jog/slow jog driving profile with limit switch evaluation

Preset 3 for traction and lifting drives

Function	Application
• Clock drive with time-optimized quick jog driving profile or • Quick jog/slow jog driving profile • Application switchover • Evaluation of safety limit switches • Motor holding brake actuation BRK_1	• Rack drive • Spindle drive • Trolley drive • Lifting drive • etc.



X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	"Reference reached" message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Limit switch left
11	ISD02	Limit switch right
10	ISD01	Start/Stop quick jog anti-clockwise
9	ISD00	Start/Stop quick jog clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX 0 ... 10 V corresponds to 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Selection of slow jog
2	ISA00	User data set switchover
1	U_R	Reference voltage 10 V, 10 mA

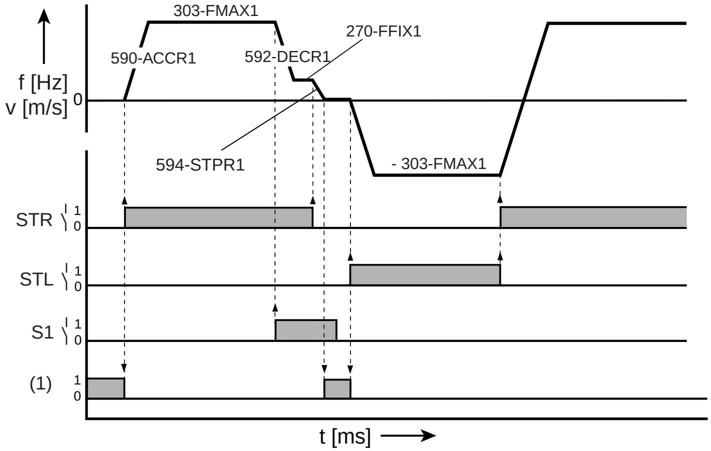
Figure 4.7 Control terminal assignment with ASTER = DRV_3

Note: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD, DRIVEMANAGER) to TERM (terminal operation) and save (see section 5.1 "_15FC-Initial commissioning").

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 "Comparison of parameters, traction and lifting drive".

When interconnecting analog and digital ground, refer to the notes in section 2.6 "Isolation concept". Electromagnetically compatible wiring is essential, and must be provided.

Input signals



(1) DC braking torque, subject area _68HO

Figure 4.8 Example of use of the control terminal preset with ASTER = DRV_3

The output signals are shown in section 4.3.1 "DRV_1", Figure 4.4.

User data set switchover (switchable offline)

S1	Active UDS	Example
0	UDS 1 for application 1	x-axis, traction drive
1	UDS 2 for application 2	z-axis, lifting drive

Table 4.9 User data set switchover

Limit switch evaluation

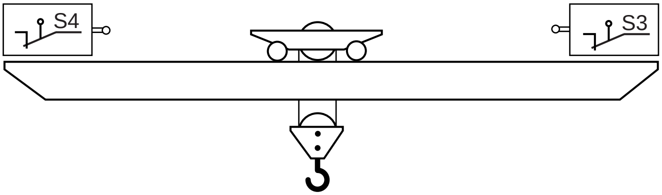


Figure 4.9 Example of a limit switch evaluation

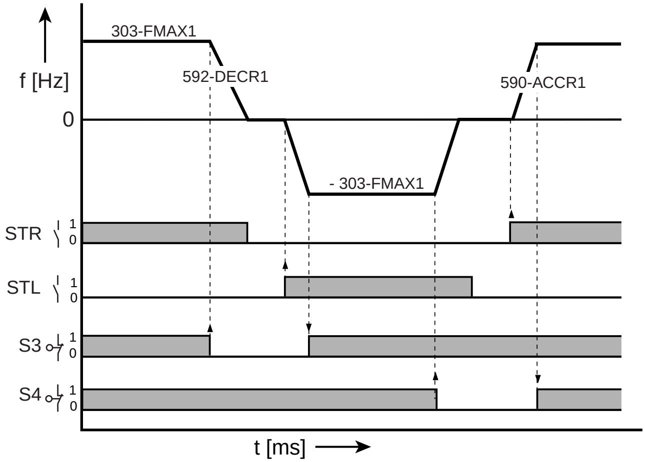


Figure 4.10 Limit switch evaluation of S4 and S3

Example: Limit switch right resets Start Clockwise. Resetting of Start Clockwise is not evaluated. The Start Anti-clockwise command can be used to move out of the limit switch zone.

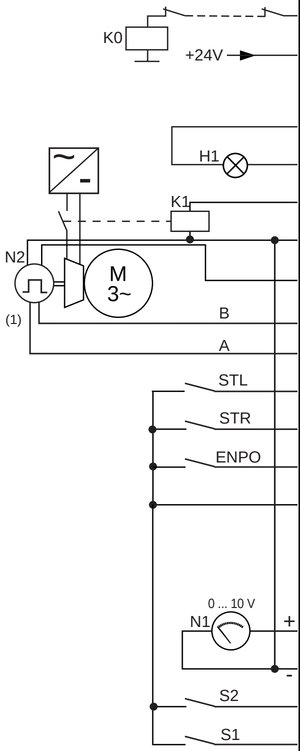
Note: Overriding the limit switches is not permitted! For this reason, a mechanical override guard must be provided. The limit switches are evaluated on the basis of evaluation of static signals and not based on signal edges, so an override is not evaluated.

4.3.4 DRV_4

Clock drive with fixed frequency and encoder evaluation

Preset 4 for traction and lifting drives

Function	Application
• Clock drive with time-optimized driving profile • Switchover for application • Encoder evaluation • Motor holding brake actuation BRK_1	• Conveyor belt • Rack drive • Spindle drive • Trolley drive • Lifting drive • etc.



X2	Des.	Function
20	OSD02/14	Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	"Reference reached" message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX 0 ... 10 V corresponds to 0 ... FMAX
4	AGND	Analog ground
3	ISA01	User data set switchover
2	ISA00	User data set switchover
1	U_R	Reference voltage 10 V, 10 mA

(1) The encoder is evaluated only in control mode FOR.
For notes on the encoder, see Figure 4.12 or section 6.3.1 "_79EN-Encoder evaluation"

Figure 4.11 Control terminal assignment with ASTER = 4

Note: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD, DRIVEMANAGER) to TERM (terminal operation) and save (see section 5.1 "_15FC-Initial commissioning").

When interconnecting analog and digital ground, refer to the notes in section 2.6 "Isolation concept". Electromagnetically compatible wiring is essential, and must be provided.

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 "Comparison of parameters, traction and lifting drive".

Attention! When control mode FOR is changed to VFC in parameter 300-CFCON, it is essential that the response at reference value 0 Hz in parameter 597-RF0 should be set to OFF, otherwise current will be continuously applied to the motor in uncontrolled mode while at standstill. This may result in the motor overheating.

Encoder

A HTL encoder (see Figure 4.12) can be connected to terminals X2:11 and X2:12.

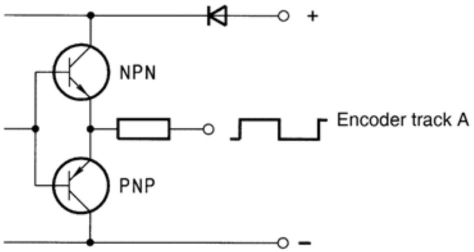


Figure 4.12 Block diagram, HTL output circuit

Input signals

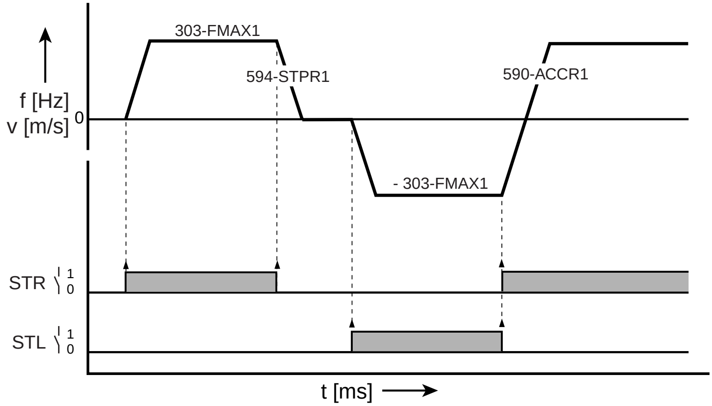


Figure 4.13 *Example of a quick jog driving profile for two directions of rotation (ASTER = DRV_4)*

The output signals are shown in section 4.3.1 "DRV_1", Figure 4.4.

User data set switchover (switchable offline)

S1	S2	Active UDS	Example
0	0	UDS 1 for application 1	x-axis, traction drive
1	0	UDS 2 for application 2	y-axis, traction drive
0	1	UDS 3 for application 3	z-axis, lifting drive
1	1	UDS 4 for application 4	Sorting belt

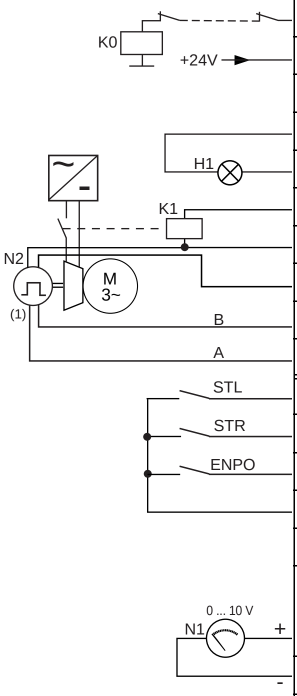
Table 4.10 *User data set switchover*

4.3.5 DRV_5

Clock drive with fixed frequencies, encoder and limit switch evaluation

Preset 5 for traction and lifting drives

Function	Application
• Clock drive with time-optimized driving profile • Selection of fixed frequencies • Encoder evaluation • Limit switch evaluation • Switchover of applications	• Conveyor belt • Rack drive • Trolley drive • Spindle drive • Lifting drive

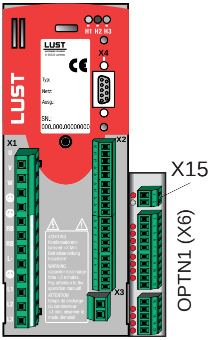


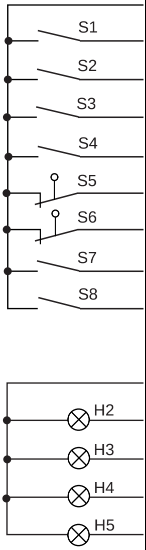
X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	"Reference reached" message
15	OSD00	Output for motor holding brake
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX 0 ... 10 V corresponds to 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Not assigned
1	U_R	Reference voltage 10 V, 10 mA

(1) The encoder is evaluated only in control mode FOR. For notes on the encoder, see Figure 4.12 or section 6.3.1 "_79EN-Encoder evaluation".

Figure 4.14 Control terminal assignment with ASTER = DRV_5

Control terminals of user module UM-8I4O





X15	Des.	Function
1	U_V	24 V supply +20%, 0.6 A
2	DGND	Digital ground
21	U_V	Auxiliary voltage 24 V
22	IED00	Switch to driving sets
23	IED01	Select driving sets for fixed frequencies (section 5.5.5 _60TB Driving sets)
24	IED02	
25	IED03	
26	IED04	Limit switch right
27	IED05	Limit switch left
28	IED06	User data set switchover
29	IED07	
30	DGND	Digital ground
31	DGND	Digital ground
32	OED00	Warning "Inverter module overloaded"
33	OED01	Warning "Motor overloaded"
34	OED02	Warning "80% of I_N exceeded"
35	OED03	Warning "Ambient temperature too high"

Figure 4.15 Assignment of control terminal expansion with ASTER = DRV_5

Note: If limit switch evaluation is not required, the 24 V auxiliary voltage (UV_V) should be jumpered from terminal X15:21 directly to terminals X15:26 and X15:27 of the limit switch inputs. As an alternative, both digital inputs can also be deactivated with function selectors 218-FIE04 and 219-FIE05 respectively, or be assigned a different function (see section 5.2.3).

Note: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD, DRIVEMANAGER) to TERM (terminal operation) and save (see section 5.1 "_15FC-Initial commissioning").

Note: Signal evaluation of the digital inputs on the CDA3000 inverter module is state-controlled and on the terminal expansion module it is edge-controlled.

The parameter presets for application data sets DRV_x are located as parameter comparison references in section 4.3.6 "Comparison of parameters, traction and lifting drive".

Input signals

v/t diagram

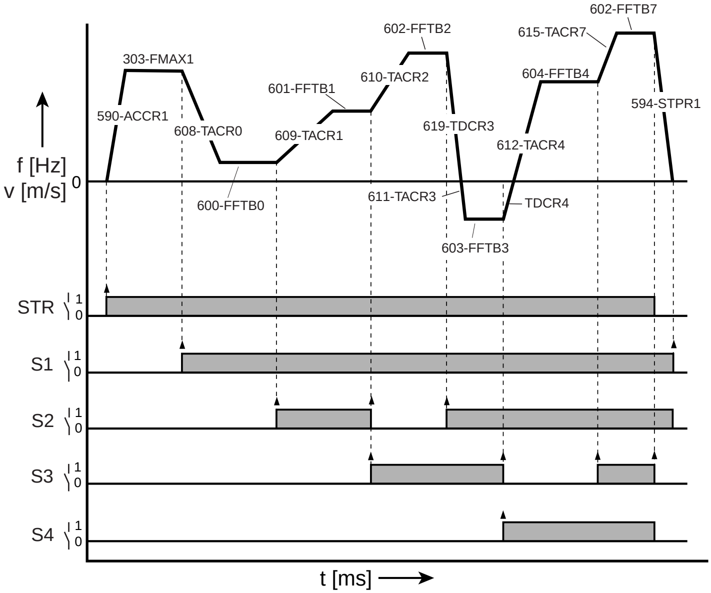


Figure 4.16 Example of use of table sets with fixed frequencies and ramps (ASTER = DRV_5)

The output signals are shown in section 4.3.1 "DRV_1", Figure 4.4.

User data set switchover (switchable offline)

S7	S8	Active UDS	Example
0	0	UDS 1 for application 1	x-axis, traction drive
1	0	UDS 2 for application 2	y-axis, traction drive
0	1	UDS 3 for application 3	z-axis, lifting drive
1	1	UDS 4 for application 4	Sorting belt

Table 4.11 User data set switchover

4.3.6 Comparison of parameters, traction and lifting drive

Comparison of application data sets for **traction and lifting drives** with the factory setting (152-ASTER = DRV_1):

I/O	Parameter	Function	152-ASTER = DRV_1 (FS)	DRV_2	DRV_3	DRV_4	DRV_5
Initial commissioning							
	151-ASTPR	Original device preset	DRV_1	DRV_2	DRV_3	DRV_4	DRV_5
	152-ASTER	Preset within the active application data set	DRV_1	DRV_2	DRV_3	DRV_4	DRV_5
	166-UDSSL	Control location for switchover of the active user data set	PARAM		TERM	TERM	TERM
	300-CFCON	Current open-loop/closed-loop control mode of the device	VFC			FOR	FOR
Driving profile generator							
	597-RF0	Response at reference value 0 Hz	OFF			0 Hz	0 Hz
CDA3000 inverter module inputs and outputs							
ISA00	180-FISA0	Function selector analog standard input ISA00	OFF	UM0	UM0	UM0	
ISA01	181-FISA1	Function selector analog standard input ISA01	OFF	UM1	SADD1	UM1	
ISD00	210-FIS00	Function selector digital standard input ISD00	STR				
ISD01	211-FIS01	Function selector digital standard input ISD01	STL				
ISD02	212-FIS02	Function selector digital standard input ISD02	SADD1		/LCW	ENC	ENC
ISD03	213-FIS03	Function selector digital standard input ISD03	OFF	CUSEL	/LCCW	ENC	ENC
OSA00	200-FOSA0	Function selector for analog output OSA00	AACTF				
OSD00	240-FOS00	Function selector digital standard output OSD00	BRK_1				
OSD01	241-FOS01	Function selector digital standard output OSD01	REF				
OSD02	242-FOS02	Function selector digital standard output OSD02	S_RDY				
User module UM-8I4O inputs and outputs							
IED00	214-FIE00	Function selector digital input IED00	OFF				SADD1

1) Only >V.3.30: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).

Table 4.12 Automatic changes by means of the assistance parameter

I/O	Parameter	Function	152-ASTER =				
			DRV_1 (FS)	DRV_2	DRV_3	DRV_4	DRV_5
IED01	215-FIE01	Function selector digital input IED01	OFF				FFTB0
IED02	216-FIE02	Function selector digital input IED02	OFF				FFTB1
IED03	217-FIE03	Function selector digital input IED03	OFF				FFTB2
IED04	218-FIE04	Function selector digital input IED04	OFF				/LCW
IED05	219-FIE05	Function selector digital input IED05	OFF				/LCCW
IED06	220-FIE06	Function selector digital input IED06	OFF				UM0
IED07	221-FIE07	Function selector digital input IED07	OFF				UM1
OED00	243-FOE00	Function selector digital output OED01	OFF				WIIT
OED01	244-FOE01	Function selector digital output OED01	OFF				WIT
OED02	245-FOE02	Function selector digital output OED02	OFF				WIS
OED03	246-FOE03	Function selector digital output OED03	OFF				WOTD
Reference structure							
	280-RSSL1	Reference selector 1	FMAX				
	289-SADD1	Offset for reference selector 1	10			0	9
Current-controlled startup							
	640-CLSL1	CDS1: Current-controlled startup function selector	CCWFR			OFF	OFF
	645-CLSL2	CDS2: Current-controlled startup function selector	CCWFR			OFF	OFF
Characteristic data switchover							
	651-CDSSL	Characteristic data set switchover	OFF	TERM			

1) Only >V.3.30: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).

Table 4.12 Automatic changes by means of the assistance parameter

[ ] An empty line means that the setting is the same as for DRV_1 (factory setting).

Active functions with traction and lifting drive

Function	Effect	VFC	SFC	FOR
IxR load compensation	In case of load surges a higher torque is available, and the motor heats up less	✔	⊘	⊘
Current injection	Increase in starting torque	✔	⊘	⊘
Current-controlled star-tup with ramp stop	Protection against current overload shut-off in acceleration from high mass moments of inertia	✔	✔	⊗ from V2.1
DC holding	Rotation of the motor shaft without load is counteracted.	✔	⊗	⊗
Magnetization	Increase in startup and standstill torque	⊗	✔	✔

Table 4.13 Active functions

⊘ Function not available in the control mode

⊗ Function is disabled

More details of the software functions and setting options are presented in section 5 "Software functions" and section 6 "Control modes".

4.4 Rotational drive

Loading one of the application data sets ROT_1 to ROT_3 into the RAM by setting parameter 152-ASTER causes the inverter module automatically to adopt the preset of the software functions as well as all inputs and outputs for the rotational drive application.

Active functions in the preset

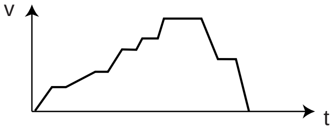
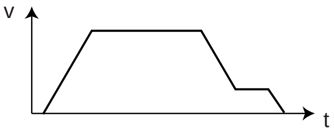
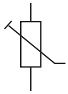
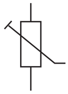
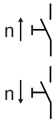
Function		152-Aster =					
		ROT_1	ROT_2	ROT_3	ROT_4	ROT_5	ROT_6
	Table sets with fixed frequencies and ramps			✔	✔		✔
	Quick jog/slow jog driving profile					✔	
	Speed input -10 to +10 V	✔	✔	✔	✔		✔
	Speed correction 0 to 10 V		✔	✔	✔		
	Speed change via button (MOP function)	✔					

Table 4.14 Presets: Rotational drives

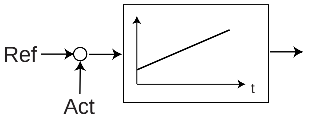
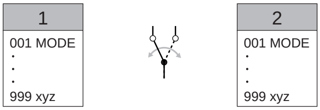
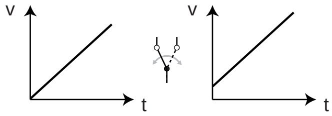
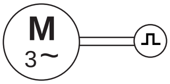
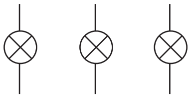
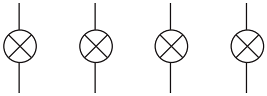
Function	152-Aster = ROT_1	ROT_2	ROT_3	ROT_4	ROT_5	ROT_6
 Process controller, PR controller with analog actual/reference value					✔	
 User data set switchover			✔			
 Characteristic data switchover					✔	
 Encoder evaluation (necessary for control mode FOR)		✔	✔			
 Messages: • Reference reached • Standstill • Ready to start	✔	✔	✔	✔	✔	✔
 Warnings: • Inverter module overloaded • 80% of IN reached • Motor overloaded • Inverter ambient temperature too high			✔			

Table 4.14 Presets: Rotational drives

Aster	Summary description	Page reference
ROT_1	"Analog speed input"	Page 4-32
ROT_2	"Analog speed input with correction value and encoder evaluation"	Page 4-34
ROT_3	"Analog speed input with correction value and switch-over to driving sets, encoder evaluation and user data set switchover"	Page 4-36
ROT_4	"Analog speed input with correction value and switch-over to driving sets"	Page 4-39
ROT_5	"Process controller with analog speed input and night reduction"	Page 4-41
ROT_6	"Analog speed input with switchover to fixed frequencies (VF1000 compatible functionality)"	Page 4-43

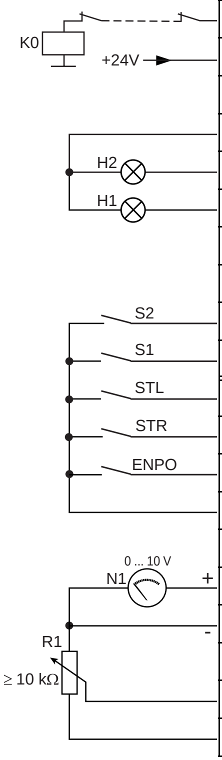
Table 4.15 Page reference to summary description of ROT_x

4.4.1 ROT_1

Analog speed input

Preset 1 for rotational drive

Function	Application
• Analog speed input for two directions of rotation • Adjustment of speed via button (MOP function)	• Spindle • Winding drive • Vacuum pumps • Extruder • Stirrer • etc.



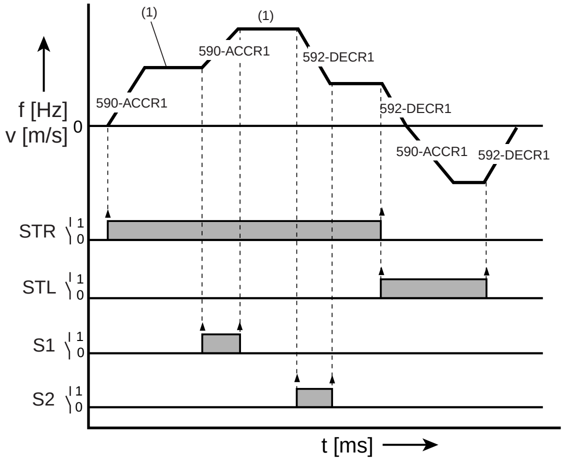
X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	"Standstill" message
15	OSD00	"Reference reached" message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Reduce speed
11	ISD02	Increase speed
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10 V, 10 mA

Figure 4.17 Control terminal assignment with ASTER = ROT_1

The parameter presets for application data sets ROT_x are located as parameter comparison references in section 4.4.7 "Comparison of parameters, rotational drives".

Input signals

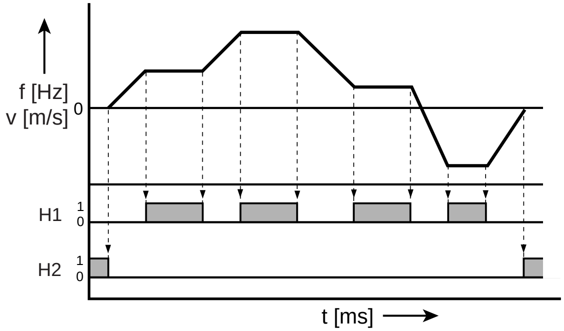
v/t diagram



(1) Reference value of ISA00

Figure 4.18 Example of a driving profile for two directions of rotation (ASTER = ROT_1)

Output signals



H1 Speed reached
H2 Standstill

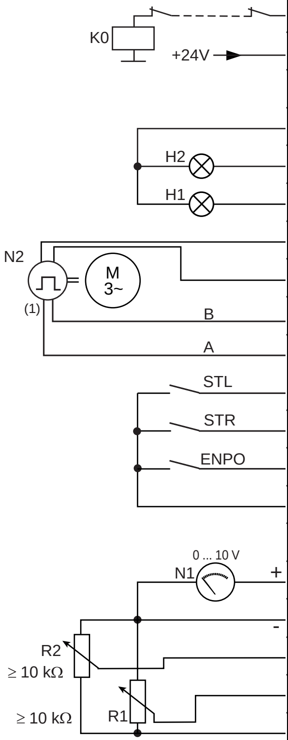
Figure 4.19 Output signals dependent on driving profile (ASTER = ROT_1, ROT_2 and ROT_3)

4.4.2 ROT_2

Analog speed input with correction value and encoder evaluation

Preset 2 for rotational drives

Function	Application
• Analog speed input for two directions of rotation • Adjustment of speed via correction value • Encoder evaluation	• Spindle • Winding drive • Extruder • etc.



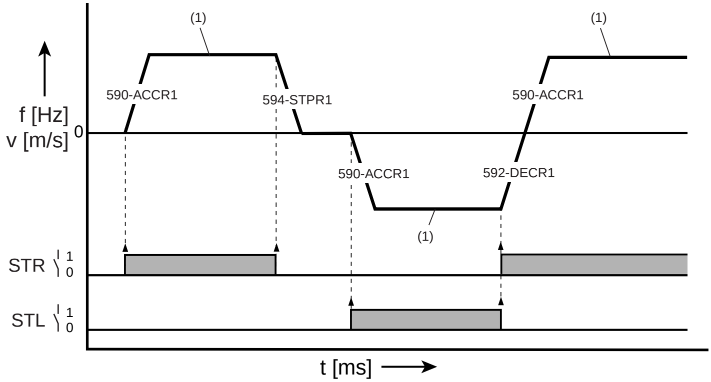
X2	Des.	Function
20	OSD02/14	14 — Relay contact for "Ready" message
19	OSD02/11	11
18	OSD02/12	12
17	DGND	Digital ground
16	OSD01	"Standstill" message
15	OSD00	"Reference reached" message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Correction value 0 V ... + 10 V
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10 V, 10 mA

(1) The encoder is evaluated only in control mode FOR. For notes on the encoder, see section 6.3.1 "_79EN-Encoder evaluation".

Figure 4.20 Control terminal device with ASTER = ROT_2

The parameter presets for application data sets ROT_x are located as parameter comparison references in section 4.4.7 "Comparison of parameters, rotational drives".

Input signals



(1) Reference value of ISA00

Figure 4.21 Example of a driving profile for two directions of rotation (ASTER = ROT_2)

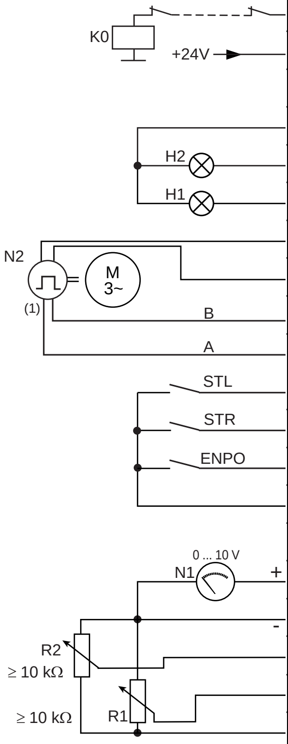
The output signals are shown in section 4.4.1 "ROT_1", Figure 4.19.

4.4.3 ROT_3

Analog speed input with switchover to driving sets, encoder evaluation and user data set switchover

Preset 3 for rotational drives

Function	Application
• Analog speed input for two directions of rotation • Adjustment of speed via correction value • Selection of driving sets • Switchover of applications • Encoder evaluation	• Spindle • Winding drive • etc.



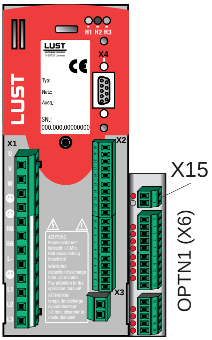
X2	Des.	Function	
20	OSD02/14	14	Relay contact for "Ready" message
19	OSD02/11	11	
18	OSD02/12	12	
17	DGND	Digital ground	
16	OSD01	"Standstill" message	
15	OSD00	"Reference reached" message	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Encoder track B	
11	ISD02	Encoder track A	
10	ISD01	Start/Stop anti-clockwise	
9	ISD00	Start/Stop clockwise	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V	Auxiliary voltage 24 V	
5	OSA00	Actual frequency 0 ... FMAX	
4	AGND	Analog ground	
3	ISA01	Correction value 0 V ... + 10 V	
2	ISA00	Reference -10 V ... + 10 V	
1	U_R	Reference voltage 10 V, 10 mA	

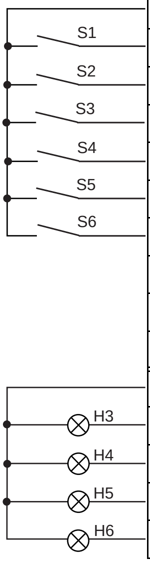
(1) The encoder is evaluated only in control mode FOR. For notes on the encoder, see Figure 4.12 or section 6.3.1 "_79EN-Encoder evaluation".

Figure 4.22 Control terminal assignment with ASTER = ROT_3

The parameter presets for application data sets ROT_x are located as parameter comparison references in section 4.4.7 "Comparison of parameters, rotational drives".

Control terminals of user module UM-8I4O





X15	Des.	Function
1	U_V	24 V supply +20%, 0.6 A
2	DGND	Digital ground
21	U_V	Auxiliary voltage 24 V
22	IED00	Switch to driving sets
23	IED01	Selection for driving sets (section 5.5.5 _60TB Driving sets)
24	IED02	
25	IED03	
26	IED04	User data set switchover
27	IED05	
28	IED06	Not assigned
29	IED07	
30	DGND	Digital ground
31	DGND	Digital ground
32	OED00	Warning "Inverter module overloaded"
33	OED01	Warning "Motor overloaded"
34	OED02	Warning "80% of I_N exceeded"
35	OED03	Warning "Ambient temperature too high"

Figure 4.23 Assignment of control terminal expansion with ASTER = ROT_3

When interconnecting analog and digital ground, refer to the notes in section 2.6 "Isolation concept". Electromagnetically compatible wiring is essential, and must be provided.

Input signals

v/t diagram

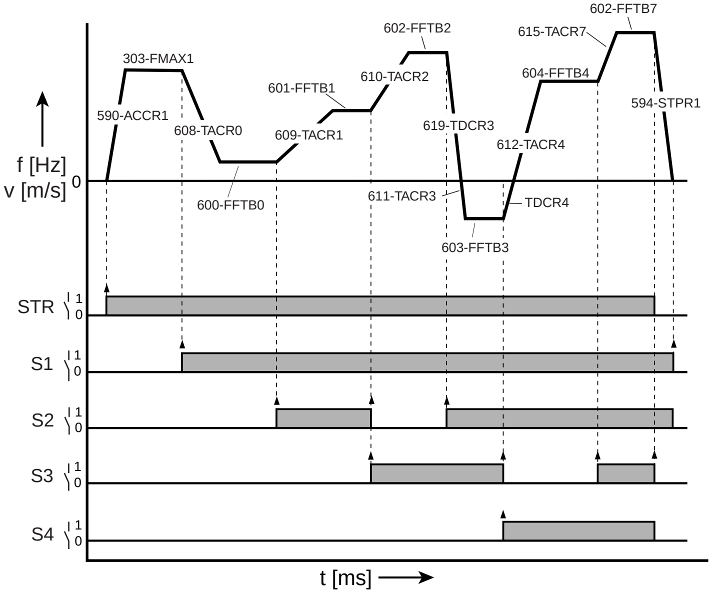


Figure 4.24 Example of use of table sets with ramps (ASTER = ROT_3)

The output signals are shown in section 4.4.1 "ROT_1", Figure 4.19.

User data set switchover (switchable offline)

S5	S6	Active UDS	Example
0	0	UDS 1 for application 1	Spindle 1
1	0	UDS 2 for application 2	Spindle 2
0	1	UDS 3 for application 3	Spindle 3
1	1	UDS 4 for application 4	Sorting belt

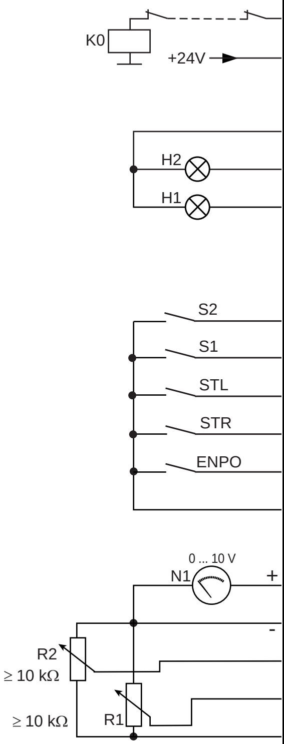
Table 4.16 User data set switchover

4.4.4 ROT_4

Analog speed input with switchover to driving sets

Preset 4 for rotational drives

Function	Application
• Analog speed input for two directions of rotation • Adjustment of speed via correction value • Selection of driving sets	• Spindle • Winding drive • etc.



X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	"Standstill" message
15	OSD00	"Reference reached" message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Driving set 1
11	ISD02	Driving set 2
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Correction value 0 V ... + 10 V
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10 V, 10 mA

Figure 4.25 Control terminal assignment with ASTER = ROT_4

Input signals

v/t diagram

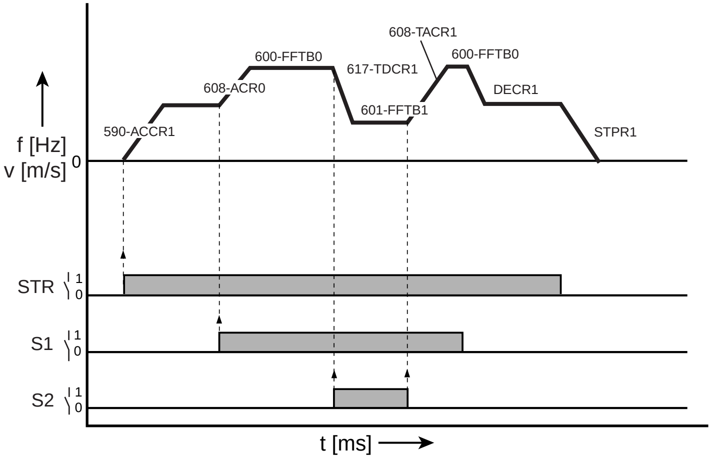


Figure 4.26 Example of use of ASTER = ROT_4

The output signals are shown in section 4.4.1 "ROT_1", Figure 4.19.

Selection of reference source

S1	S2	Active reference source	Reference value (FS)
0	0	Analog inputs ISA00 and ISA01	variable
1	0	Table set 0 (608-TACR0, 600_FFTB0, 616-TDCR0)	5 Hz
1	1	Table set 1 (609-TACR1, 601-FFTB1, 617-TDCR1)	10 Hz

Table 4.17 Fixed frequency selection or analog reference input

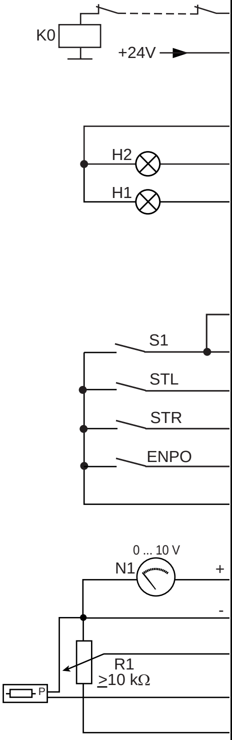
With switch S1 the reference selector 1 (parameter 280-RSSL1) is influenced to determine the reference input via analog input ISA01 or driving set selection.

4.4.5 ROT_5

Process controller with analog speed input and night reduction

Preset 5 for rotational drives

Function	Application
• Analog actual value recording for PR controller • Analog speed input for PR controller • Selection of a night reduction	• Pumps • Winding drives • etc.

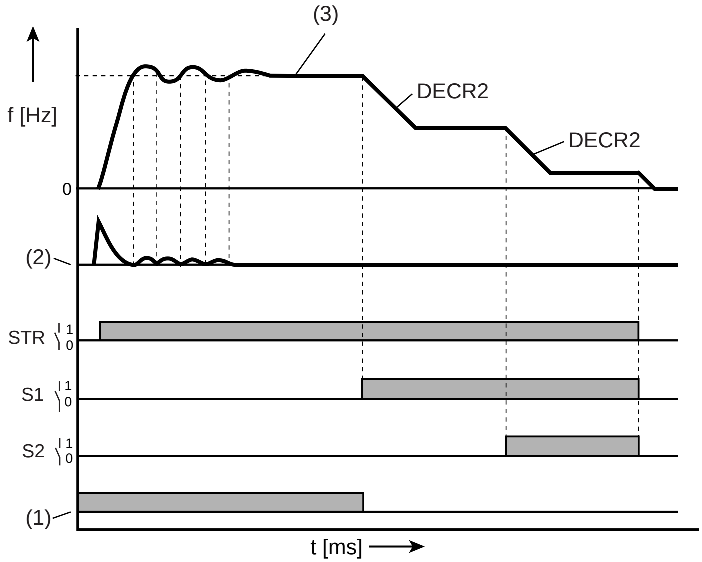


X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	
16	OSD01	"Standstill" message
15	OSD00	"Reference reached" message
14	DGND	
13	U_V	
12	ISD03	
11	ISD02	Night lowering
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	
6	U_V	
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Controller reference 0 V ... + 10 V
2	ISA00	Controller actual -10 V ... + 10 V
1	U_R	Reference voltage 10 V, 10 mA

Figure 4.27 Control terminal assignment with ASTER = ROT_5

Attention! When using a firmware version ≥ V3.3 in the ROT_5 function, after loading any parameter data set based on a firmware version < V3.3 the process controller must be deactivated, see section 5.5.16 "_82PR-Process controller". The process controller is not deactivated automatically in this case.

v/t diagram



(1) PR controller active (CDS switchover)
(2) Control deviation as amount
(3) Analog reference value of ISA01

Figure 4.28 Example of use of ASTER = ROT_5

The output signals are shown in section 4.4.1 "ROT_1", Figure 4.19.

Selection of reference source

S1	S2	Active reference source
0	0	Analog input ISA01
1	0	Night lowering (271-FFIX2)

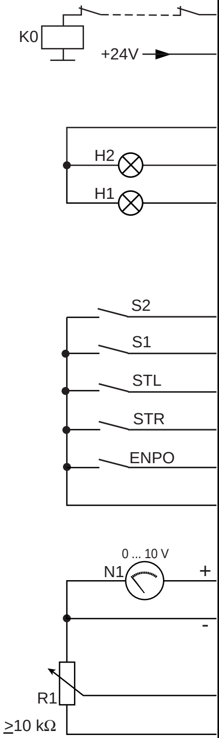
Table 4.18 Fixed frequency selection or analog reference source

4.4.6 ROT_6

Analog speed input with switchover to fixed frequencies (VF1000 compatible functionality)

Preset 6 for rotational drives

Function	Application
• VF1000-compatible functionality • Analog speed input for two directions of rotation • Selection of fixed frequencies via binary coding of switches • Uniform driving profile ramps for analog speed input and fixed frequencies	• Spindle • Winding drive • etc.



X2	Des.	Function	
20	OSD02/14	14	Relay contact for "Ready" message
19	OSD02/11	11	
18	OSD02/12	12	
17	DGND	Digital ground	
16	OSD01	"Standstill" message	
15	OSD00	"Reference reached" message	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Choice of fixed frequency (binary coded) *	
11	ISD02		
10	ISD01	Start/Stop anti-clockwise	
9	ISD00	Start/Stop clockwise	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V	Auxiliary voltage 24 V	
5	OSA00	Actual frequency 0 ... FMAX	
4	AGND	Analog ground	
3	ISA01	Not assigned	
2	ISA00	Reference -10 V ... +10 V	
1	U_R	Reference voltage 10 V, 10 mA	

* Function, see following Table 4.19

Figure 4.29 Control terminal assignment with ASTER = ROT_6

Reference	S2 (ISD03)	S1 (ISD02)	ISA00
Analog reference at input ISA00 (R1)	0	0	active
Table frequency 601-FFTB1 (FS = 10Hz)	0	1	inactive
Table frequency 602-FFTB2 (FS = 15Hz)	1	0	inactive
Table frequency 603-FFTB3 (FS = 20Hz)	1	1	inactive

Table 4.19 Scaling of binary coded inputs ISD02 (S1) and ISD03 (S2)

Input signals

v/t diagram

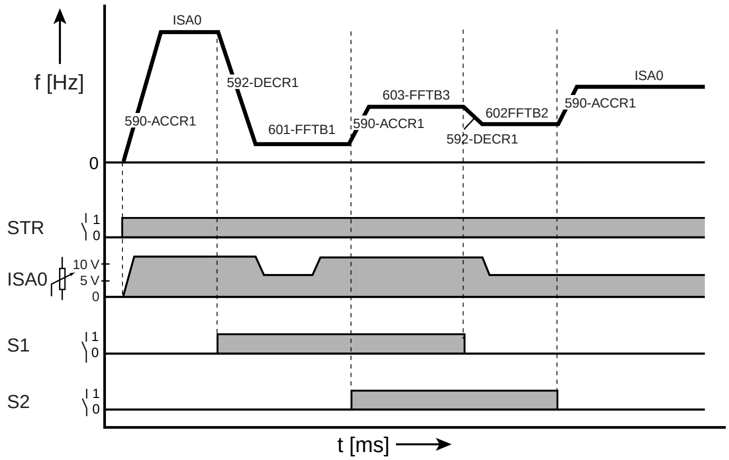


Figure 4.30 Example of use of analog speed input and fixed frequencies

The output signals are shown in section 4.4.1 "ROT_1", Figure 4.19.

Selection of reference source

S1	S2	Active reference source	Reference value (FS)
0	0	Analog input ISA00	variable
1	0	Table set 1 (601-FFTB1, 590-ACCR1, 592-DECR1)	10 Hz
0	1	Table set 2 (602-FFTB2, 590-ACCR1, 592-DECR1)	15 Hz
1	1	Table set 3 (603-FFTB3, 590-ACCR1, 592-DECR1)	20 Hz

Table 4.20 Fixed frequency selection or analog reference input with uniform ramps from subject area _59DP-Driving profile generator

4.4.7 Comparison of parameters, rotational drives

Comparison of the application data sets for **rotational drives** with the factory setting (152-ASTER = DRV_1):

I/O	Parameter	Function	152-ASTER = DRV_1 (FS)	ROT_1	ROT_2	ROT_3	ROT_4	ROT_5	ROT_6
Initial commissioning									
	151-ASTPR	Original device preset	DRV_1	ROT_1	ROT_2	ROT_3	ROT_4	ROT_5	ROT_6
	152-ASTER	Preset within the active application data set	DRV_1	ROT_1	ROT_2	ROT_3	ROT_4	ROT_5	ROT_6
	166-UDSSL	Control location for switchover of the active user data set	PARAM			TERM			
	300-CFCON	Current open-loop/closed-loop control mode of the device	VFC		FOR	FOR			
Driving profile generator									
	597-RF0	Response at reference value 0 Hz	OFF		0 Hz	0 Hz			
CDA3000 inverter module inputs and outputs									
ISA00	180-FISA0	Function selector analog standard input ISA00	OFF	PM10 V	PM10 V	PM10 V	PM10 V	PM10 V	PM10 V
ISA01	181-FISA1	Function selector analog standard input ISA01	OFF		0-10V	0-10 V	0-10 V	0-10 V	
ISD00	210-FIS00	Function selector digital standard input ISD00	STR						
ISD01	211-FIS01	Function selector digital standard input ISD01	STL						
ISD02	212-FIS02	Function selector digital standard input ISD02	SADD1	MP-UP	ENC	ENC		CUSEL	FFTB0
ISD03	213-FIS03	Function selector digital standard input ISD03	OFF	MP-DN	ENC	ENC	FFTB0	SADD1	FFTB1
OSA00	200-FOSA0	Function selector for analog output OSA00	AACTF						
OSD00	240-FOS00	Function selector digital standard output OSD00	BRK_1	REF	REF	REF	REF	REF	REF
OSD01	241-FOS01	Function selector digital standard output OSD01	REF	ROT_0	ROT_0	ROT_0	ROT_0	ROT_0	ROT_0
OSD02	242-FOS02	Function selector digital standard output OSD02	S_RDY						

1) Only >V.3.30: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).

Table 4.21 Automatic changes by means of the assistance parameter

I/O	Parameter	Function	152-ASTER = DRV_1 (FS)	ROT_1	ROT_2	ROT_3	ROT_4	ROT_5	ROT_6
User module UM-8I40 inputs and outputs									
IED00	214-FIE00	Function selector digital input IED00	OFF			SADD1			
IED01	215-FIE01	Function selector digital input IED01	OFF			FFTB0			
IED02	216-FIE02	Function selector digital input IED02	OFF			FFTB1			
IED03	217-FIE03	Function selector digital input IED03	OFF			FFTB2			
IED04	218-FIE04	Function selector digital input IED04	OFF			UM0			
IED05	219-FIE05	Function selector digital input IED05	OFF			UM1			
OED01	243-FOE00	Function selector digital output OED01	OFF			WIIT			
OED01	244-FOE01	Function selector digital output OED01	OFF			WIT			
OED02	245-FOE02	Function selector digital output OED02	OFF			WIS			
OED03	246-FOE03	Function selector digital output OED03	OFF			WOTD			
Fixed frequencies									
	271-FFIX2	Fixed frequency CDS2	20					8	
Reference structure									
	280-RSSL1	Reference selector 1	FMAX	FA0	FA0	FA0	FA0	FA1	FA0
	281-RSSL2	Reference selector 2	FCON		FA1	FA1	FA1		
	289-SADD1	Offset for reference selector 1	10	0	0	7	7	7	
MOP function									
	320-MPSEL	Configuration for motor operated potentiometer	OFF	F1					
Driving sets									
	625-DPSEL	Ramp selection of driving sets	TAB						DP2
Current-controlled startup									
	640-CLSL1	DS1: Function selector	CCWFR	CCWFR	OFF	OFF	CCWFR	OFF	CCWFR
	645-CLSL2	DS2: Function selector	CCWFR	CCWFR	OFF	OFF	CCWFR	OFF	CCWFR
Characteristic data switchover CDS									
	651-CDSSL	Control location of the characteristic data set (CDS)	OFF					TERM	

1) Only >V.3.30: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).

Table 4.21 Automatic changes by means of the assistance parameter

I/O	Parameter	Function	152-ASTER =						
			DRV_1 (FS)	ROT_1	ROT_2	ROT_3	ROT_4	ROT_5	ROT_6
DC holding									
	681-HODCT	Holding time	0.5	0	0	0	0	0	0
Process controller									
	820-PRCT1	CDS1: PR controller On/Off	OFF					ON	
1) Only >V.3.30: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KeyPad KP200, DriveManager) to TERM (terminal operation).									

Table 4.21 Automatic changes by means of the assistance parameter

[ ] An empty line means that the setting is the same as for DRV_1 (factory setting).

Active functions with rotational drives

Function	Effect	VFC	SFC	FOR
IxR load compensation	In case of load surges a higher torque is available, and the motor heats up less	✔	⊘	⊘
Current injection	Increase in starting torque	✔	⊘	⊘
Current-controlled star-tup with ramp reversal	Protection against current overload shut-off in acceleration from high load torques Protection against drive stalling Acceleration and deceleration proc-esses with maximum dynamics along the current limit	✔	✔	⊗ from V2.1
Magnetization	Increase in startup and standstill torque	⊗	✔	✔

Table 4.22 Active functions

⊘ Function not available in the control mode

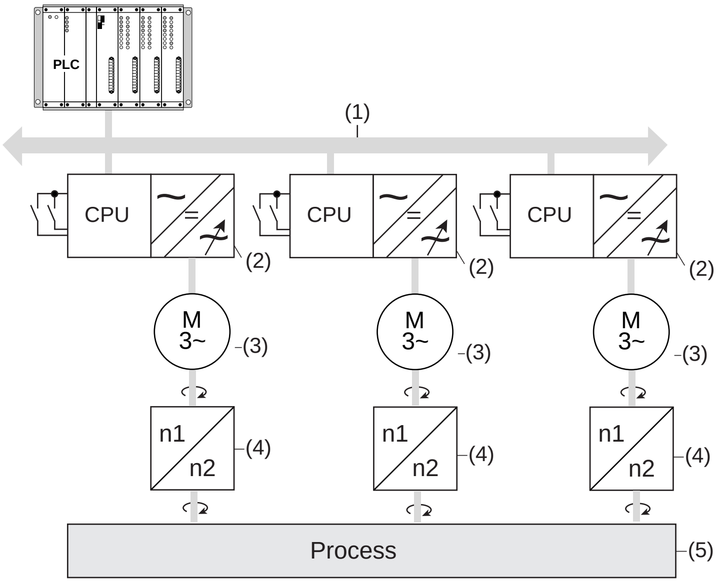
⊗ Function is disabled

More details of the software functions and setting options are presented in section 5 "Software functions" and section 6 "Control modes".

4.5 Field bus operation

Setting parameter 152-ASTER loads one of the application data sets BUS_1 to BUS_3 into the RAM (see Figure 4.1 in section 4.1 "Activating an application data set"). As a result the software functions and the inputs and outputs for the field bus operation application are preset.

The precondition for field bus operation is that an appropriate communication module is mounted on the CDA3000.



(1) Field bus
(2) Inverter module
(3) IEC standard motor
(4) Gearing
(5) Application

Figure 4.31 Drive solution: "Field bus operation"

Active functions in the preset

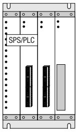
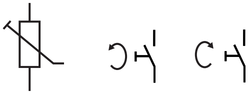
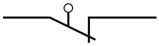
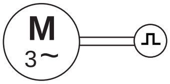
Function		BUS_1	BUS_2	BUS_3	BUS_4	BUS_5
	Reference and control via PLC	✔	✔	✔	✔	✔
IN1 IN2 IN3 IN4 OUT1 OUT2 OUT3	Digital inputs and outputs readable and writable over the bus	✔	✔	✔	✔	✔
	Manual mode independent of bus		✔	✔		✔
	Limit switch evaluation			✔		
	Encoder evaluation (for control mode FOR)				✔	✔

Table 4.23 Presets - field bus operation

Aster	Summary description	Page reference
BUS_1	"Control via field bus (complete)"	Page 4-52
BUS_2	"Control via field bus" and "additional emergency operation"	Page 4-53
BUS_3	"Control via field bus" and "additional emergency operation with limit switch evaluation"	Page 4-55
BUS_4	"Control via field bus in FOR mode"	Page 4-57
BUS_5	"Control via field bus in FOR mode with additional emergency operation"	Page 4-58

Table 4.24 Page reference to summary description of BUS_x

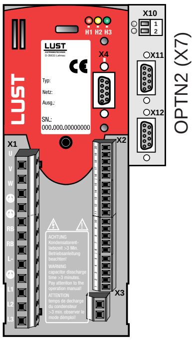
In field bus operation the "auto-start" function is active in the preset.

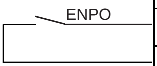
4.5.1 BUS_1

Control via field bus (complete)

Preset 1 for field bus operation

Function	Application
• Control of the inverter module over the field bus • Setting and reading of digital inputs and outputs over the field bus	• Traction and lifting drive • Rotational drive





X2	Des.	Function	
20	OSD02/14	14	Relay contact Output 3
19	OSD02/11	11	
18	OSD02/12	12	
17	DGND	Digital ground	
16	OSD01	Digital output 2	
15	OSD00	Digital output 1	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Digital input 4	
11	ISD02	Digital input 3	
10	ISD01	Digital input 2	
9	ISD00	Digital input 1	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V		
5	OSA00	Analog output	
4	AGND	Analog ground	
3	ISA01	Analog output 2	
2	ISA00	Analog output 1	
1	U_R	Reference voltage 10 V, 10 mA	

Figure 4.32 Control terminal configuration with ASTER = BUS_1

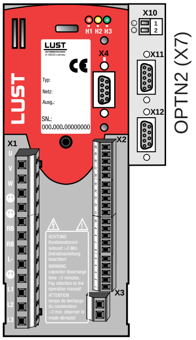
The parameter presets for application data sets BUS_x are located as parameter comparison references in section 4.5.6 "Comparison of parameters, field bus operation".

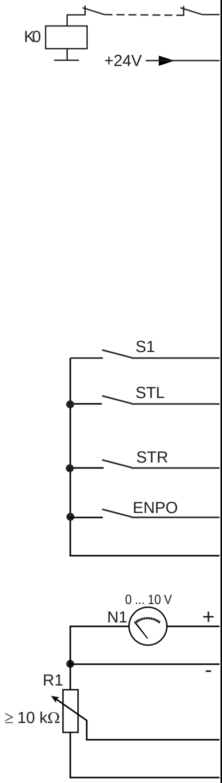
4.5.2 BUS_2

Control via field bus and additional emergency operation

Preset 2 for field bus operation

Function	Application
• Control of the inverter module over the field bus • Control of the device in emergency also independently of field bus • Manual/automatic switchover • Setting and reading of digital inputs and outputs over the field bus	• Traction and lifting drive • Rotational drive



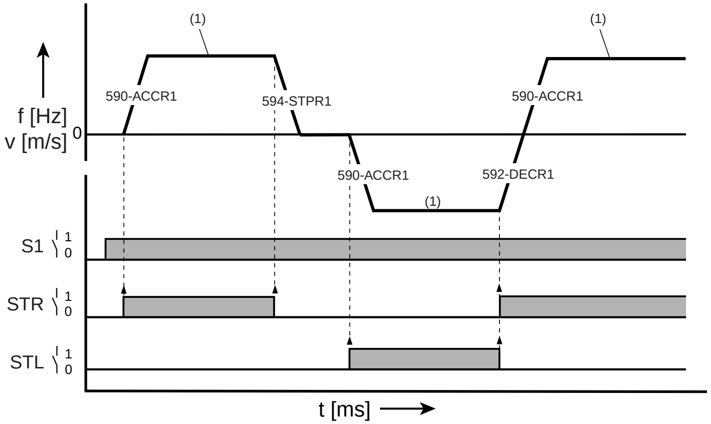


X2	Des.	Function	
20	OSD02/14	14	Relay contact for "Ready" message
19	OSD02/11	11	
18	OSD02/12	12	
17	DGND	Digital ground	
16	OSD01	Digital output 2	
15	OSD00	Digital output 1	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Digital input 4	
11	ISD02	Selection of manual mode	
10	ISD01	Start/Stop anti-clockwise for manual mode	
9	ISD00	Start/Stop clockwise for manual mode	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V	Auxiliary voltage 24 V	
5	OSA00	Actual frequency 0 ... FMAX	
4	AGND	Analog ground	
3	ISA01	Not assigned	
2	ISA00	Reference for manual mode 0...10 V	
1	U_R	Reference voltage 10 V, 10 mA	

Figure 4.33 Control terminal configuration with ASTER = BUS_2

The parameter presets for application data sets BUS_x are located as parameter comparison references in section 4.5.6 "Comparison of parameters, field bus operation".

Input signals



(1) Analog reference value of ISA00

Figure 4.34 Example of use of manual mode independently of bus operation, ASTER = BUS_2

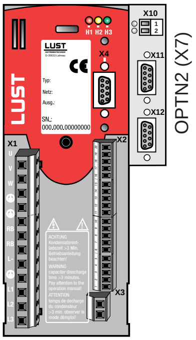
Note: While the "MAN" function is active, the settings must not be saved in the device, as the reference structure is changed in the background and the "MAN" function would be activated after the next power-on.

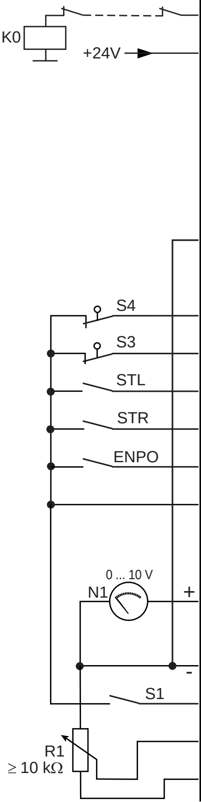
4.5.3 BUS_3

Control via field bus and additional emergency operation with limit switch evaluation

Preset 3 for field bus operation

Function	Application
• Control of the inverter module over the field bus • Control of the device in emergency also independently of field bus • Manual/automatic switchover • Evaluation of safety limit switches	• Traction and lifting drive



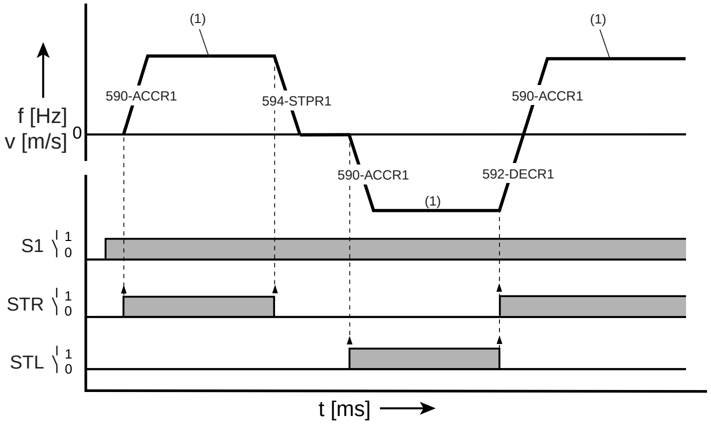


X2	Des.	Function
20	OSD02/14	14 — Relay contact for "Ready" message
19	OSD02/11	11
18	OSD02/12	12
17	DGND	Digital ground
16	OSD01	Digital output 2
15	OSD00	Digital output 1
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Limit switch left
11	ISD02	Limit switch right
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX 0 ... 10 V corresponds to 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Selection of manual mode
2	ISA00	Reference for manual mode 0...10 V
1	U_R	Reference voltage 10 V, 10 mA

Figure 4.35 Control terminal configuration with ASTER = BUS_3

The parameter presets for application data sets BUS_x are located as parameter comparison references in section 4.5.6 "Comparison of parameters, field bus operation".

When interconnecting analog and digital ground, refer to the notes in section 2.6 "Isolation concept". Electromagnetically compatible wiring is essential, and must be provided.



(1) Analog reference value of ISA00

Figure 4.36 Example of use of emergency operation independently of bus operation ASTER = BUS_3

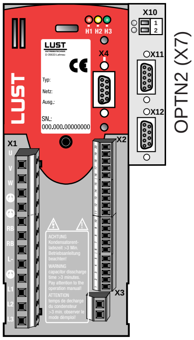
The mode of functioning of the limit switch evaluation is presented in Figure 4.9 and Figure 4.10 in section 4.3.3 "DRV_3".

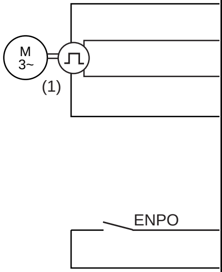
4.5.4 BUS_4

Control via field bus in FOR mode

Preset 4 for field bus operation

Function	Application
• Control of the inverter module over the field bus • FOR mode with encoder evaluation • Setting and reading of digital inputs and outputs over the field bus	• Traction and lifting drive • Rotational drive





X2	Des.	Function	
20	OSD02/14	14	Relay contact Output 3
19	OSD02/11	11	
18	OSD02/12	12	
17	DGND	Digital ground	
16	OSD01	Digital output 2	
15	OSD00	Digital output 1	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Encoder track B	
11	ISD02	Encoder track A	
10	ISD01	Digital input 2	
9	ISD00	Digital input 1	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V		
5	OSA00	Analog output	
4	AGND	Analog ground	
3	ISA01	Analog output 2	
2	ISA00	Analog output 1	
1	U_R	Reference voltage 10 V, 10 mA	

(1) The encoder is evaluated only in control mode FOR. For notes on the encoder, see section 6.3.1 "_79EN-Encoder evaluation".

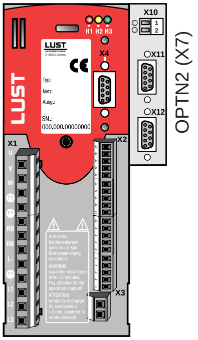
Figure 4.37 Control terminal configuration with ASTER = BUS_4

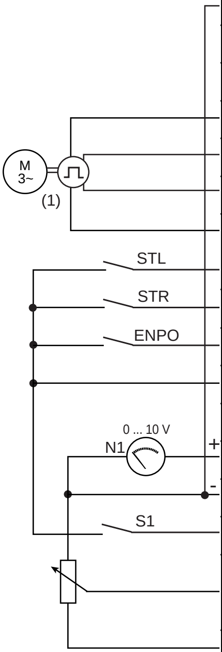
4.5.5 BUS_5

Control via field bus in FOR mode with additional emergency operation

Preset 5 for field bus operation

Function	Application
• Control of the inverter module over the field bus • FOR mode with encoder evaluation • Setting and reading of digital inputs and outputs over the field bus • Manual/automatic switchover • Control of the device also independently of field bus	• Traction and lifting drive • Rotational drives





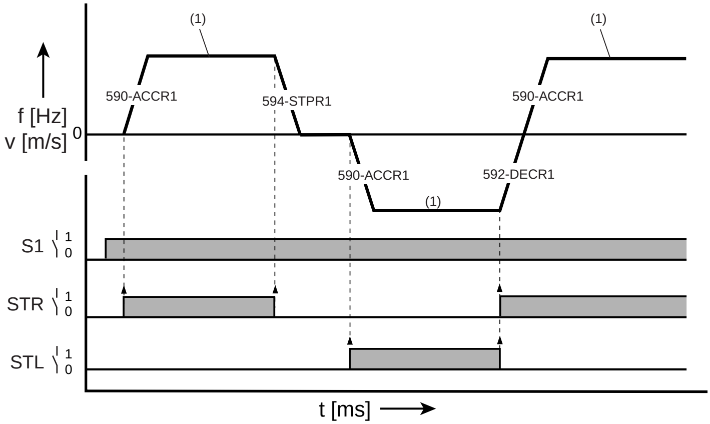
X2	Des.	Function	
20	OSD02/14	14	Relay contact Message for "Ready"
19	OSD02/11	11	
18	OSD02/12	12	
17	DGND	Digital ground	
16	OSD01	Digital output 2	
15	OSD00	Digital output 1	
14	DGND	Digital ground	
13	U_V	Auxiliary voltage 24 V	
12	ISD03	Encoder track B	
11	ISD02	Encoder track A	
10	ISD01	Digital input 2	
9	ISD00	Digital input 1	
8	ENPO	Power stage hardware enable	
7	U_V	Auxiliary voltage 24 V	
6	U_V		
5	OSA00	Analog output	
4	AGND	Analog ground	
3	ISA01	Selection of manual mode	
2	ISA00	Reference for manual mode 0 ... 10 V 1	
1	U_R	Reference voltage 10 V, 10 mA	

(1) The encoder is evaluated only in control mode FOR. For notes on the encoder, see section 6.3.1 "_79EN-Encoder evaluation".

Figure 4.38 Control terminal configuration with ASTER = BUS_5

When interconnecting analog and digital ground, refer to the notes in section 2.6 "Isolation concept". Electromagnetically compatible wiring is essential, and must be provided.

Input signals



(1) Analog reference value of ISA00

Figure 4.39 Example of use of manual mode independently of bus operation, ASTER = BUS_5

Note: While the "MAN" function is active, the settings must not be saved in the device, as the reference structure is changed in the background and the "MAN" function would be activated after the next power-on.

4.5.6 Comparison of parameters, field bus operation

Comparison of the application data sets for **field bus operation** with the factory setting (152-ASTER = DRV_1):

I/O	Parameter	Function	152-ASTER = DRV_1 (FS)	BUS_1	BUS_2	BUS_3	BUS_4	BUS_5
Initial commissioning								
	151-ASTPR	Original device preset	DRV_1	BUS_1	BUS_2	BUS_3	BUS_4	BUS_5
	152-ASTER	Preset within the active application data set	DRV_1	BUS_1	BUS_2	BUS_3	BUS_4	BUS_5
	166-UDSSL	Control location for switchover of the active user data set	PARAM	OPTN2	OPTN2	OPTN2	OPTN2	OPTN2
	300-CFCON	Current open-loop/closed-loop control mode of the device	VFC				FOR	FOR
CDA3000 inverter module inputs and outputs								
ISA00	180-FISA0	Function selector analog standard input ISA00	OFF	OPTN2	PM10V	PM10V	OPTN2	PM10V
ISA01	181-FISA1	Function selector analog standard input ISA01	OFF	OPTN2		MAN	OPTN2	MAN
ISD00	210-FIS00	Function selector digital standard input ISD00	STR	OPTN2			OPTN2	
ISD01	211-FIS01	Function selector digital standard input ISD01	STL	OPTN2			OPTN2	
ISD02	212-FIS02	Function selector digital standard input ISD02	SADD1	OPTN2	MAN	/LCW	ENC	ENC
ISD03	213-FIS03	Function selector digital standard input ISD03	OFF	OPTN2	OPTN2	/LCCW	ENC	ENC
OSA00	200-FOSA0	Function selector for analog output OSA00	AACTF	OFF			OFF	
OSD00	240-FOS00	Function selector digital standard output OSD00	BRK_1	OPTN2	OPTN2	OPTN2	OPTN2	OPTN2
OSD01	241-FOS01	Function selector digital standard output OSD01	REF	OPTN2	OPTN2	OPTN2	OPTN2	OPTN2
OSD02	242-FOS02	Function selector digital standard output OSD02	S_RDY	OPTN2			OPTN2	
Reference structure								
	280-RSSL1	Reference selector 1	FMAX	FOPT2	FOPT2	FOPT2	FOPT2	FOPT2
	281-RSSL2	Reference selector 2	FCON					
	289-SADD1	Offset for reference selector 1	10	0	0	0	0	0
Control location								
	7-AUTO	Auto-Start	OFF	ON	ON	ON	ON	ON
	260-CLSEL	Control location selector	TERM	OPTN2	OPTN2	OPTN2	OPTN2	OPTN2

1)Only >V.3.5: After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to OPTN2 (bus operation).

Table 4.25 Automatic changes by means of the assistance parameter

An empty line means that the setting is the same as for DRV_1 (factory setting).

Active functions in field bus operation

Function	Effect	VFC	SFC	FOR
IxR load compensa-tion	In case of load surges a higher torque is available, and the motor heats up less	✔	⊘	⊘
Current injection	Increase in starting torque	✔	⊘	⊘
Current-controlled startup with ramp stop	Protection against current overload shut-off in acceleration from high load torques	✔	✔	✔
DC holding	Rotation of the motor shaft without load is counteracted	✔	⊗	⊗
Magnetization	Increase in coasting and standstill torque	⊗	✔	✔

Table 4.26 Active functions

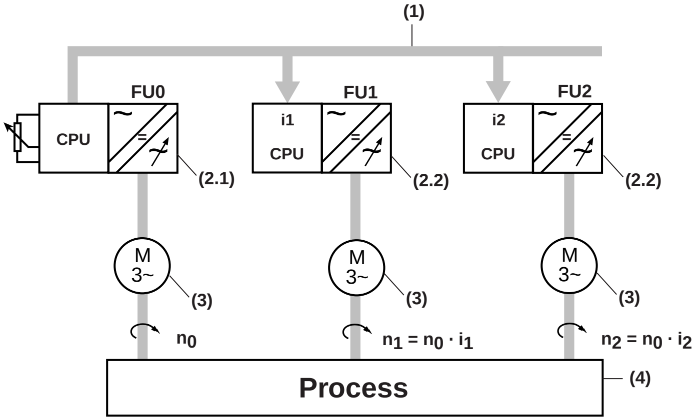
⊘ Function not available in the control mode

⊗ Function is disabled

More details of the software functions and setting options are presented in section 5 "Software functions" and section 6 "Control modes".

4.6 Master/Slave operation

Application data sets M-S_1 to M-S_4 contain settings for Master/Slave operation between inverter modules.



(1) Reference coupling
(2) Inverter module
(2.1) Master
(2.2) Slave
(3) IEC standard motor
(4) Application

Figure 4.40 Drive solution "Master/Slave operation"

In Master/Slave operation the reference values of max. 6 inverter modules are permanently coupled together. The reference value of the master is also the guide value for the devices connected to the master (slaves). The master transmits the reference value to the slaves by way of a data telegram. In each slave the guide value received from the master can be programmed, meaning that any desired transmission ratios can be set. In this way it is possible to replace mechanical speed couplings.

Note: Coupling of the electrical axles in control modes VFC and SFC causes the motors to run at a fixed ratio. Only in the FOR control mode do the motors run speed-synchronous.

Characteristics of the control methods in comparison

Properties	VFC Voltage Frequency Control	SFC Sensorless Flux Control	FOR Field-Oriented Regulation
Speed adjustment range $M=M_{Nom}$	1 : 20	1 : 50	> 1 : 10000
Static speed accuracy referred to the rated speed	typically 1 to 5%	typically 0.5%	Quartz-accurate
Frequency resolution	0.01 Hz	0.0625 Hz	2^{-16}

Table 4.27 Comparison of motor control methods

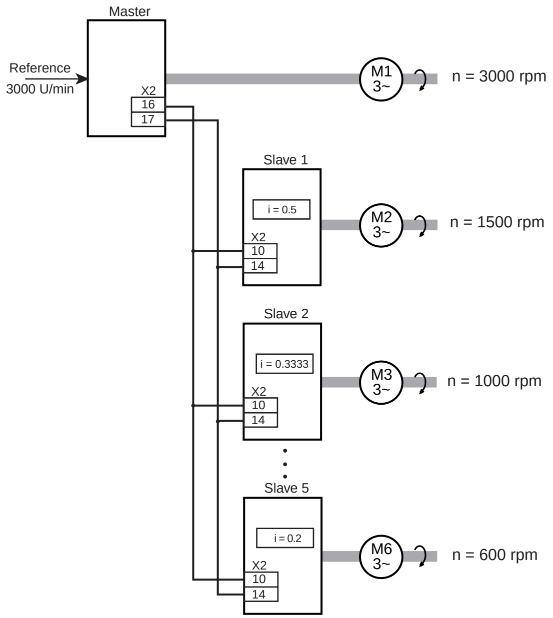


Figure 4.41 Master/Slave coupling via two control cables

Note: In primary frequency coupling a dead time of max. 2 ms is created between the axes.

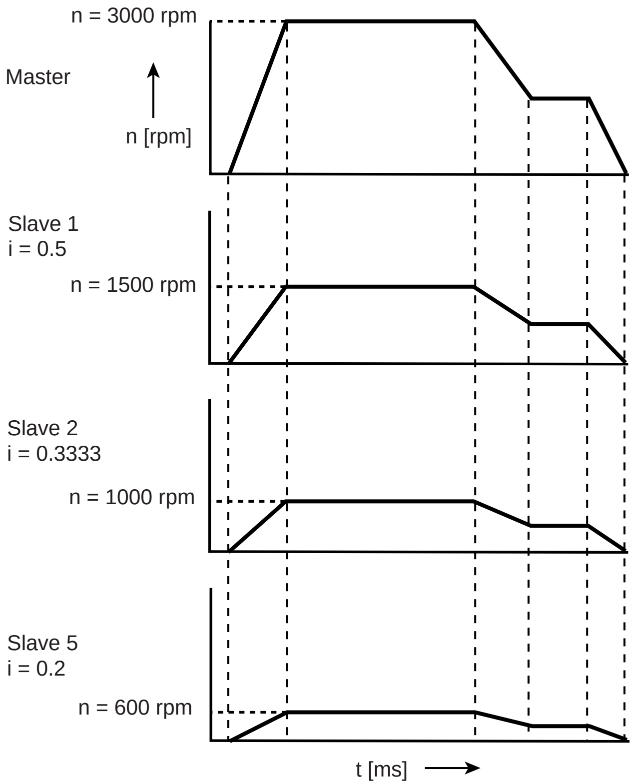


Figure 4.42 Speed curve in Master/Slave operation

Active functions in the preset

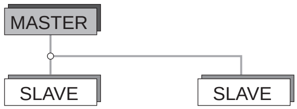
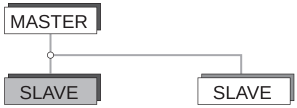
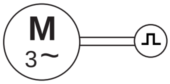
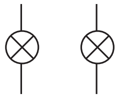
Function		152-ASTER =			
		M-S1[1]	M-S2[2]	M-S3[3]	M-S4[4]
	Inverter module is master	✔	✔		
	Inverter module is slave			✔	✔
	Speed change via button (MOP function)	✔		✔	
	Encoder evaluation		✔		✔
	Messages: • Standstill • Ready to start	✔	✔	✔	✔

Table 4.28 PresetsMaster/Slave operation

Aster	Summary description	Page reference
M-S_1	"Master drive with analog guide value input"	Page 4-66
M-S_2	"Master drive with encoder evaluation"	Page 4-68
M-S_3	"Slave drive"	Page 4-70
M-S_4	"Slave drive with encoder evaluation"	Page 4-73

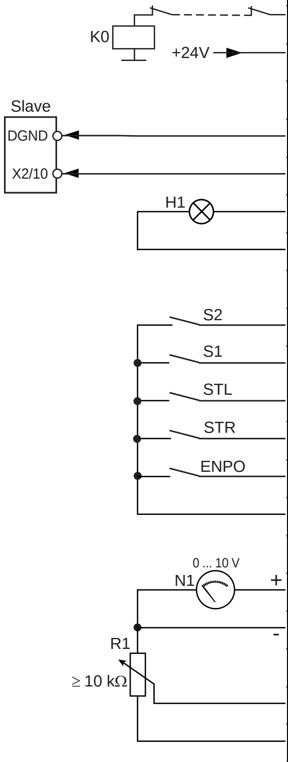
Table 4.29 Page reference to summary description of M-S_x

4.6.1 M-S_1

Master drive with analog guide value input

Preset 1 for Master/Slave operation

Function	Application
• Speed synchronism of several drives with programmable transmission ratio • Inverter module is master • Digital guide value input • Adjustment of guide value via button (MOP function)	• Replacement of mechanical gears and line shafts (not angle-synchro-nous) • Winding drive • Drafting equipment • Trolley drive



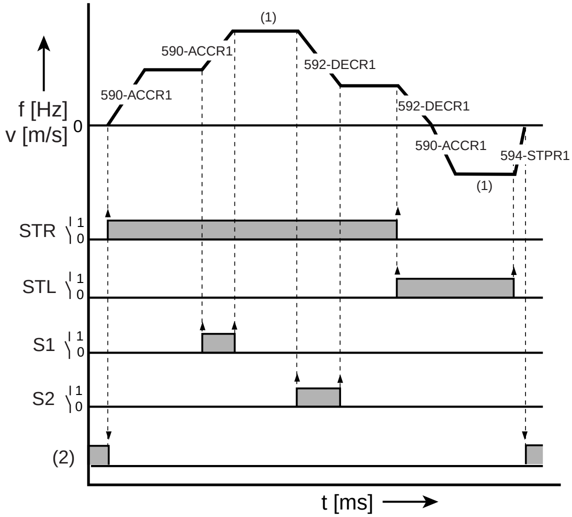
X2	Des.	Function
20	OSD02/14	Relay contact for "Ready" message (14 / 11 / 12)
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	Slave interface
15	OSD00	"Standstill" message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Reduce speed
11	ISD02	Increase speed
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10 V, 10 mA

Figure 4.43 Control terminal assignment with ASTER = M-S_1

The parameter presets for application data sets M-S_x are located as parameter comparison references in section 4.6.5 "Comparison of parameters, Master/Slave operation".

Input signals

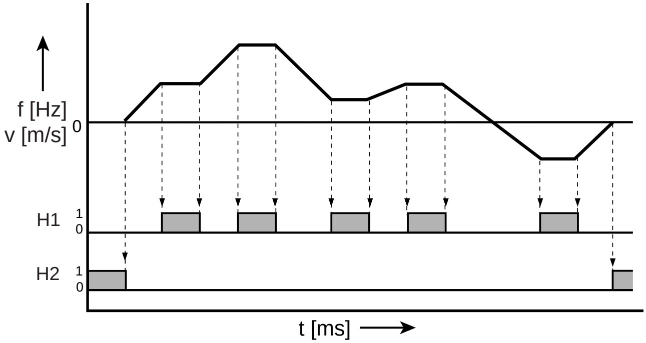
v/t diagram



(1) Analog reference value of ISA00
(2) DC holding torque

Figure 4.44 Example of a driving profile for two directions of rotation (ASTER = ROT_2)

Output signals



H1 Reference reached
H2 Standstill

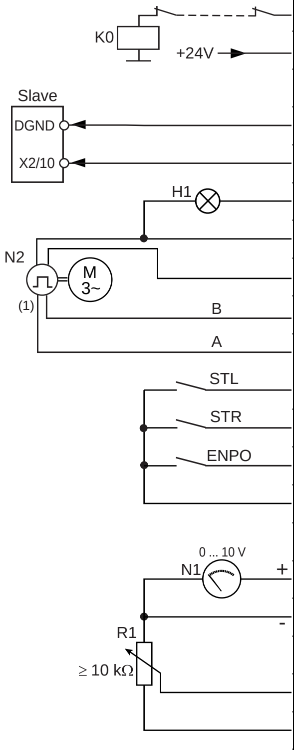
Figure 4.45 Output signals dependent on driving profile (ASTER = M-S_1 and M-S_2)

4.6.2 M-S_2

Master drive with encoder evaluation

Preset 2 for Master/Slave operation

Function	Application
• Speed synchronism of several drives with programmable transmission ratio • Inverter module is master • Digital guide value input • Encoder evaluation	• Replacement of mechanical gears and line shafts (not angle-synchronous) • Winding drive • Drafting equipment • Trolley drive



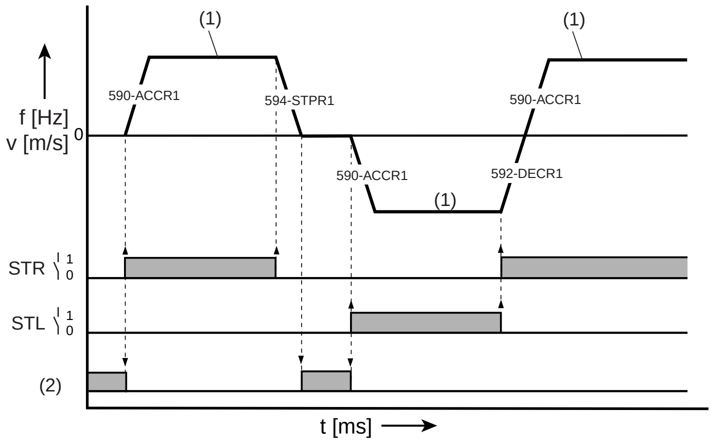
X2	Des.	Function
20	OSD02/14	14 / 11 / 12 – Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	Slave interface
15	OSD00	"Standstill" message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Start/Stop anti-clockwise
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Reference -10 V ... + 10 V
1	U_R	Reference voltage 10 V, 10 mA

(1) The encoder is evaluated only in control mode FOR.
For notes on the encoder, see section 6.3.1 "_79EN-Encoder evaluation".

Figure 4.46 Control terminal assignment with ASTER = M-S_2

The parameter presets for application data sets M-S_x are located as parameter comparison references in section 4.6.5 "Comparison of parameters, Master/Slave operation".

Input signals



(1) Analog reference value of ISA00
(2) DC holding torque

Figure 4.47 Example of a driving profile for two directions of rotation (ASTER = M-S_2)

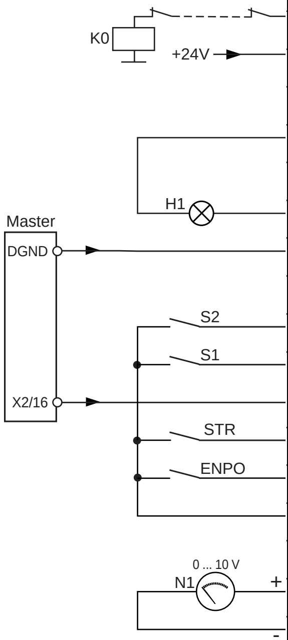
The basic characteristic of the output signals is shown in 4.6.1 "M-S_1", Figure 4.45.

4.6.3 M-S_3

Slave drive

Preset 3 for Master/Slave operation

Function	Application
• Speed synchronism of several drives with programmable transmission ratio • Inverter module is slave • Adjustment of guide value via button (MOP function)	• Replacement of mechanical gears and line shafts (not angle-synchronous) • Winding drive • Drafting equipment • Trolley drive

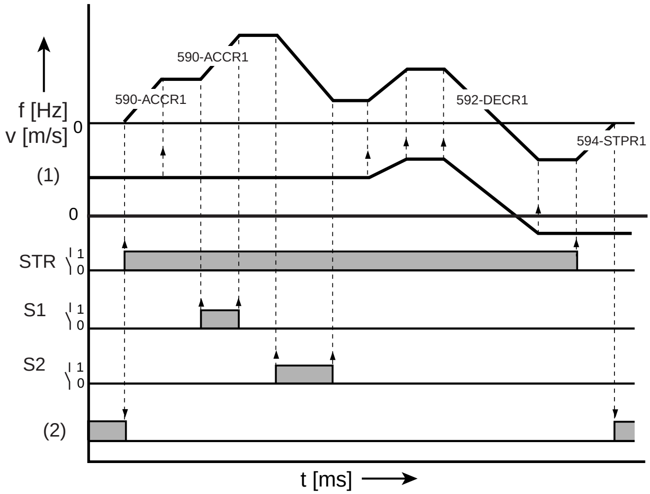


X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	Disabled in M/S operation
15	OSD00	"Standstill" message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Reduce speed
11	ISD02	Increase speed
10	ISD01	Master interface
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Not assigned
1	U_R	Reference voltage 10 V, 10 mA

Figure 4.48 Control terminal assignment with ASTER = M-S_3; with S1 and S2 an offset can be added to or subtracted from the guide value

The parameter presets for application data sets M-S_x are located as parameter comparison references in section 4.6.5 "Comparison of parameters, Master/Slave operation".

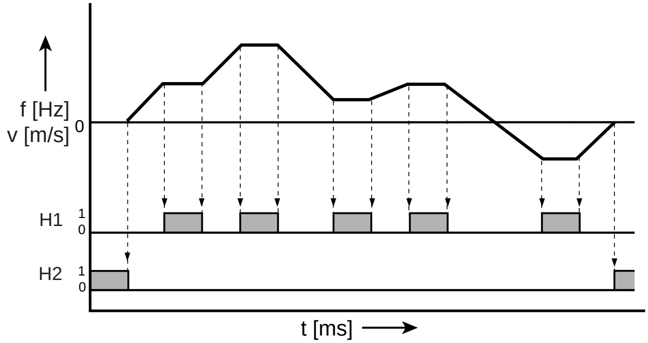
Input signals



(1) Guide value from master
(2) DC holding torque

Figure 4.49 Example of a driving profile with Master/Slave coupling (ASTER = M-S_3)

Output signals



H1 Reference reached
H2 Standstill

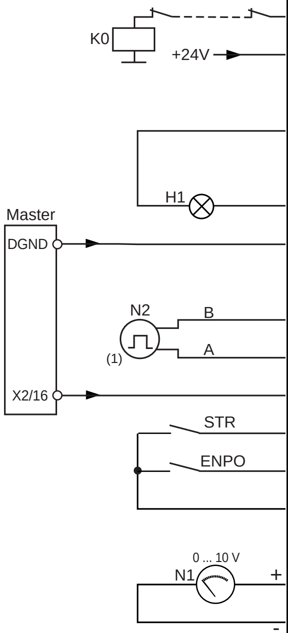
Figure 4.50 Output signals dependent on driving profile (ASTER = M-S_3 and M-S_4)

4.6.4 M-S_4

Slave drive with encoder evaluation

Preset 4 for Master/Slave operation

Function	Application
• Speed synchronism of several drives with programmable transmission ratio • Inverter module is slave • Encoder evaluation	• Replacement of mechanical gears and line shafts (not angle-synchronous) • Winding drive • Drafting equipment • Trolley drive



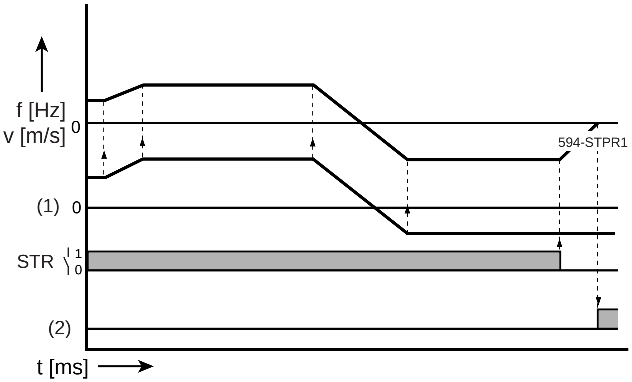
X2	Des.	Function
20	OSD02/14	14 / 11 / 12 — Relay contact for "Ready" message
19	OSD02/11	
18	OSD02/12	
17	DGND	Digital ground
16	OSD01	Disabled in M/S operation
15	OSD00	"Standstill" message
14	DGND	Digital ground
13	U_V	Auxiliary voltage 24 V
12	ISD03	Encoder track B
11	ISD02	Encoder track A
10	ISD01	Master interface
9	ISD00	Start/Stop clockwise
8	ENPO	Power stage hardware enable
7	U_V	Auxiliary voltage 24 V
6	U_V	Auxiliary voltage 24 V
5	OSA00	Actual frequency 0 ... FMAX
4	AGND	Analog ground
3	ISA01	Not assigned
2	ISA00	Not assigned
1	U_R	Reference voltage 10 V, 10 mA

(1) The encoder is evaluated only in control mode FOR.
For notes on the encoder, see section 6.3.1 "_79EN-Encoder evaluation".

Figure 4.51 Control terminal assignment with ASTER = M-S_4

The parameter presets for application data sets M-S_x are located as parameter comparison references in section 4.6.5 "Comparison of parameters, Master/Slave operation".

Input signals



(1) Guide value from master
(2) DC holding torque

Figure 4.52 Example of a driving profile with Master/Slave coupling (ASTER = M-S_4)

The basic characteristic of the output signals is shown in 4.6.3 "M-S_3", Figure 4.50.

4.6.5 Comparison of parameters, Master/Slave operation

Comparison of the application data sets for **Master/Slave operation** with the factory setting (152-ASTER = DRV_1):

I/O	Parameter	Function	152-ASTER = DRV_1 (FS)	M-S_1	M-S_2	M-S_3	M-S_4
Initial commissioning							
	151-ASTPR	Original device preset	DRV_1	M-S_1	M-S_2	M-S_3	M-S_4
	152-ASTER	Preset within the active application data set	DRV_1	M-S_1	M-S_2	M-S_3	M-S_4
	166-UDSSL	Control location for switchover of the active user data set	PARAM	1)	1)	1)	1)
	300-CFCON	Current open-loop/closed-loop control mode of the device	VFC		FOR		FOR
CDA3000 inverter module inputs and outputs							
ISA00	180-FISA0	Function selector analog standard input ISA00	OFF	PM10V	PM10V		
ISD01	211-FIS01	Function selector digital standard input ISD01	STL			FSMI	FSMI
ISD02	212-FIS02	Function selector digital standard input ISD02	SADD1	MP-UP	ENC	MP-UP	ENC
ISD03	213-FIS03	Function selector digital standard input ISD03	OFF	MP-DN	ENC	MP-DN	ENC
OSA00	200-FOSA0	Function selector for analog output OSA00	AACTF				
OSD00	240-FOS00	Function selector digital standard output OSD00	BRK_1	ROT_0	ROT_0	ROT_0	ROT_0
OSD01	241-FOS01	Function selector digital standard output OSD01	REF	FMSO	FMSO	OFF	OFF
OSD02	242-FOS02	Function selector digital standard output OSD02	S_RDY				
Reference structure							
	280-RSSL1	Reference selector 1	FMAX	FA0	FA0	FDIG	FDIG
	281-RSSL2	Reference selector 2	FCON				
	289-SADD1	Offset for reference selector 1	10	0	0		0
MOP function							
	320-MPSEL	Configuration for motor operated potentiometer	OFF	F1		F1	
Driving profile generator							
	597-RF0	Response at reference value 0 Hz	OFF		0 Hz		0 Hz
Current-controlled startup							
	640-CLSL1	DS1: Function selector	CCWFR	CCWFR	OFF	CCWFR	OFF
	645-CLSL2	DS2: Function selector	CCWFR	CCWFR	OFF	CCWFR	OFF
DC holding							
	681-HODCT	Holding time	0,5	0	0		

1) After setting the parameters of the user data sets, change parameter value 166-UDSSL from PARAM (KEYPAD KP200, DRIVEMANAGER) to TERM (terminal operation).

Table 4.30 Automatic changes by means of the assistance parameter

[ ] An empty line means that the setting is the same as for DRV_1 (factory setting).

Active functions in Master/Slave operation

Function	Effect	VFC	SFC	FOR
IxR load compensa-tion	In case of load surges a higher torque is available, and the motor heats up less	✔	⊘	⊘
Current injection	Increase in starting torque	✔	⊘	⊘
Current-controlled startup with ramp stop	Protection against current overload shut-off in acceleration from high load torques	✔	✔	✔ to V. 1.40
DC holding	Rotation of the motor shaft without load is counteracted	✔	⊗	⊗
Magnetization	Increase in coasting and standstill torque	⊗	✔	✔

Table 4.31 Active functions

⊘ Function not available in the control mode

⊗ Function is disabled

More details of the software functions and setting options are presented in section 5 "Software functions" and section 6 "Control modes".

5 Software functions

Control method parameters: ➔6 "Control modes".
Overview of all parameters: ➔Appendix A "Overview of parameters".

Explanatory notes on the following tables

"Online" column

Many parameters can be altered online, that is to say the changed value takes effect immediately. This means a change in parameter value need only be confirmed by pressing the Enter key.

Therefore these parameters do not require controller initialization by briefly removing the enable signal ENPO or the start signal.

"Factory setting" ("FS") column

The factory settings are identified by the abbreviation **FS**. The following lists and tables contain all parameters up to user level 01 -MODE = 4 in their factory setting (152-ASTER = DRV_1).

"KP/DM" and "BUS" columns

The abbreviations "KP/DM" represent the settings made in the DRIVEMANAGER and the KEYPAD KP200. "BUS" represents the setting as a digit for bus operation

Types of parameters

The software of the inverter module differentiates between different types of parameters which are marked by symbols in the parameter editor of the DRIVEMANAGER:

- Parameters dependent on the existing hardware.
  - These are automatically detected by the inverter module and their parameters set accordingly.
- Parameters dependent on the specific application.
  - These must be entered accordingly by the user.
  - In the parameter editor of the DRIVEMANAGER editable parameters are identified by this symbol .

The relevant user screens for parameter setting can be accessed from the main "CDA3000 Setup" screen.

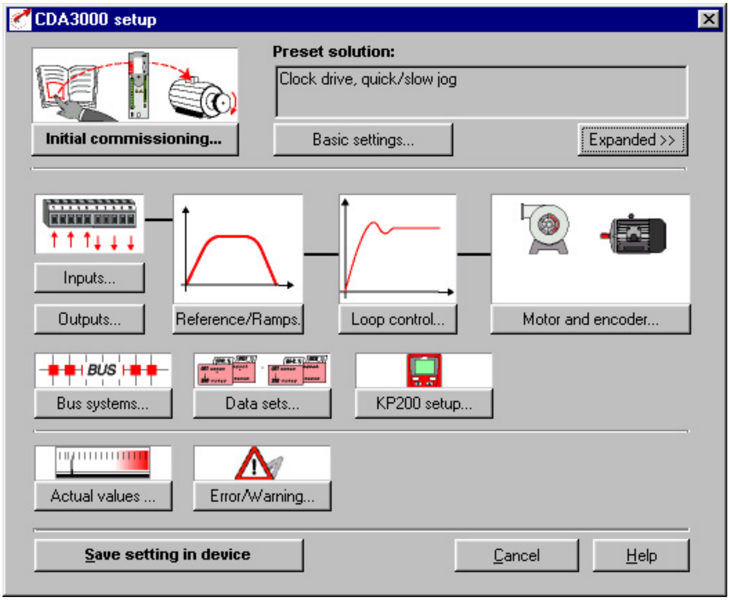


Figure 5.1 CDA3000 setup in expanded view

5.1 _15FC-Initial commissioning

Function	Application
• Input of the characteristic motor data • Selection and activation of the application data set with the preset solutions • Controller auto-tuning	• Quick and easy commissioning of the inverter module • Automatic setup of all controllers • Identification of the connected motor

The general procedure for initial commissioning is described in the operating instructions and in section 3.5.

Note: Project planning note for the minimum connected load of the motor to the frequency inverter CDA3000:

$$I_{Motor} \geq I_{CDA3000} \times 0.5$$

1.

2.

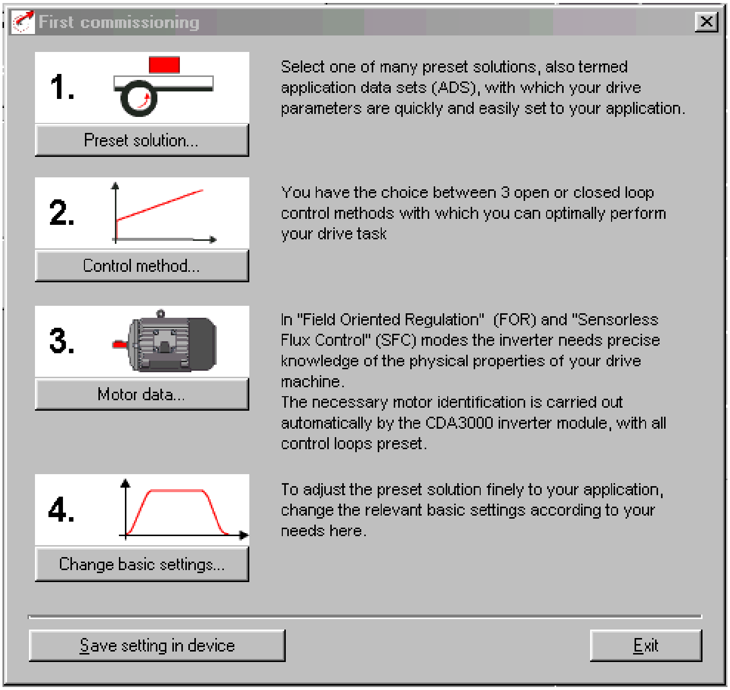


Figure 5.1 Initial commissioning

3.

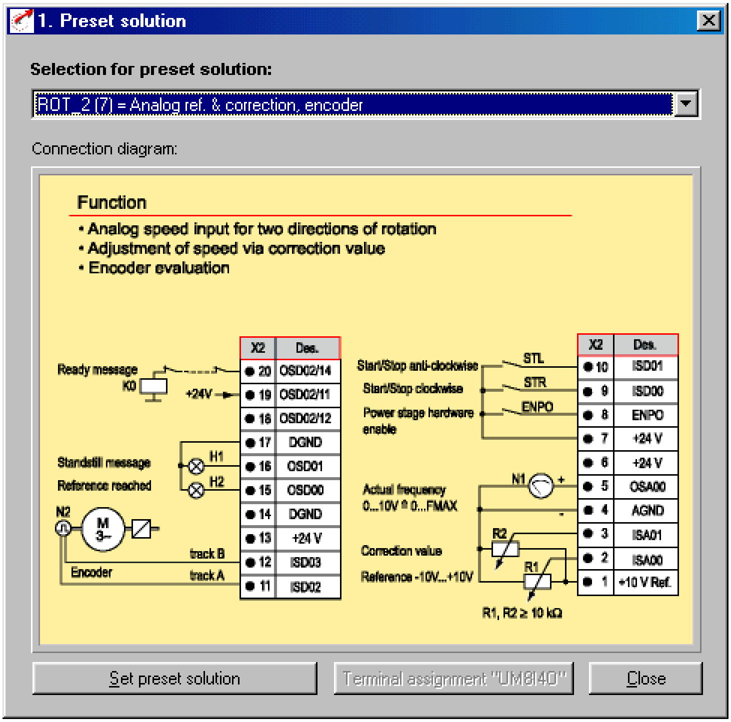


Figure 5.2 Selection of preset solution

4.

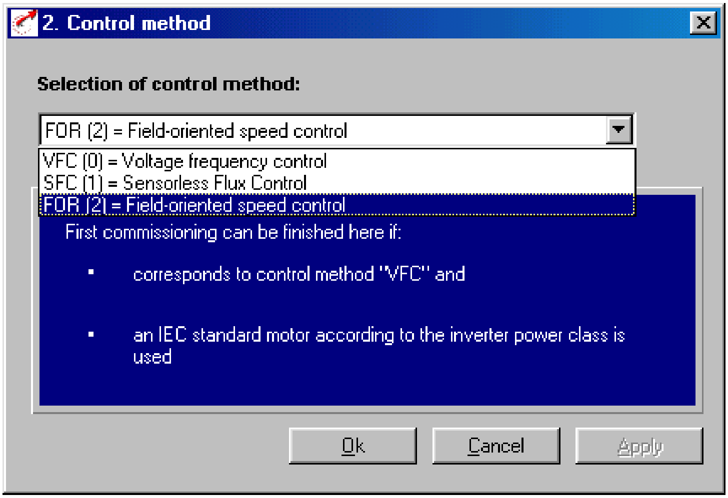


Figure 5.3 Control method

5.

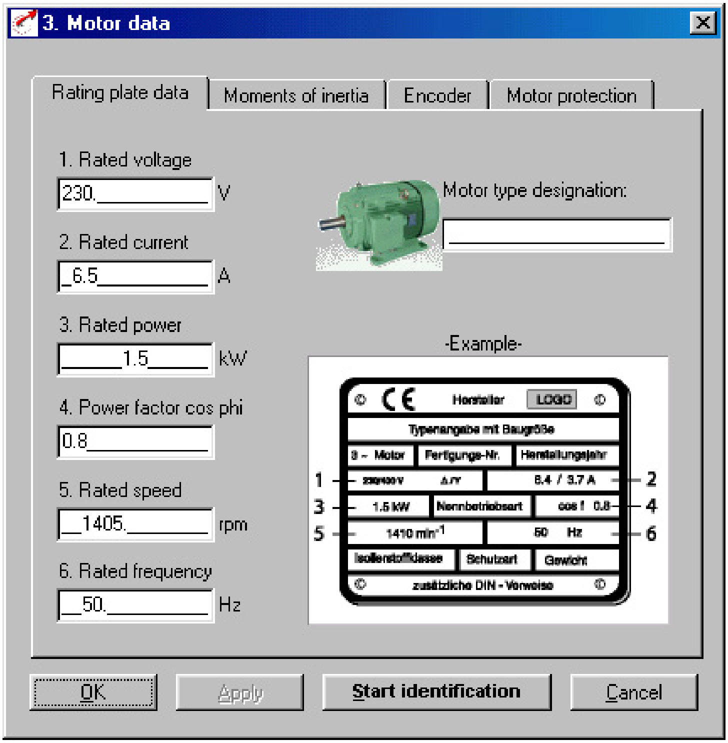


Figure 5.4 Input of motor data

6.

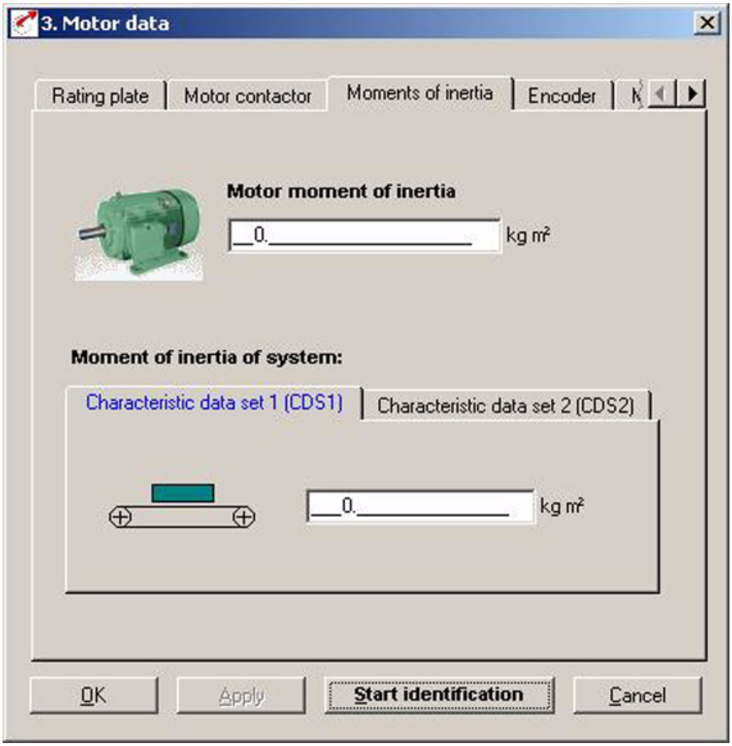


Figure 5.5 Input of moments of inertia

1
2
3
4
5
6
A
DE
EN

7.

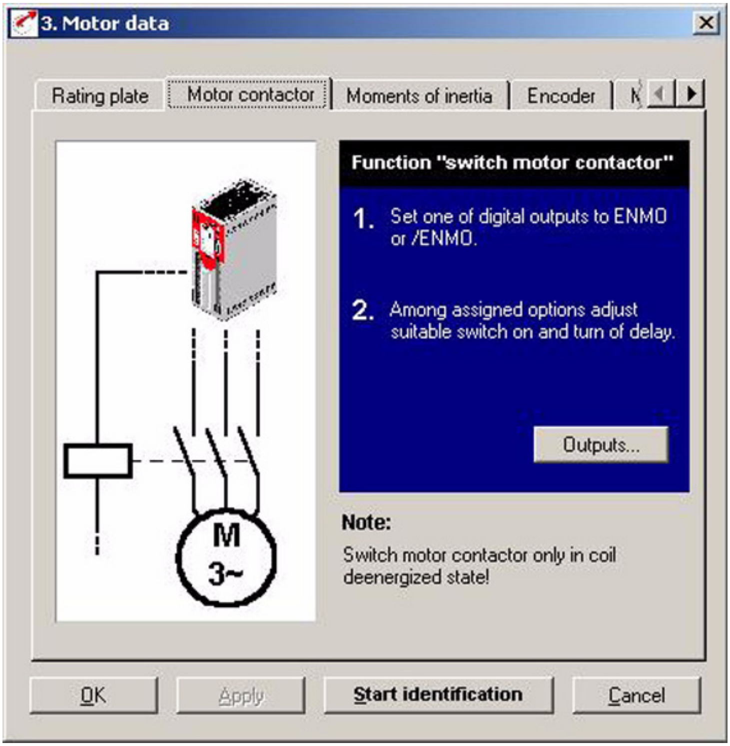


Figure 5.6 Motor contactor

When using a motor contactor, the output should be assigned the "ENMO" function as appropriate and lastly motor identification started.

Initial commissioning parameters

Parameter	Function	Value range	FS	Unit	Online
150-SAVE	Back-up device setup	STOP/START			✔
151-ASTPR	Original application data set	DRV_1 ... M-S_4	DRV_1		
152-ASTER	Current application data set (ADS)	OFF ... M-S_4 see 4.1	DRV_1		
154-MOPNM	Rated motor power	*	*	kW	
155-MOVNM	Rated motor voltage	*	*	V	
156-MOFN	Rated motor frequency	0.1 ... 1000	50	Hz	

Table 5.1 Parameters of subject area "_15FC-Initial commissioning"

157-MOSNM	Rated speed	0 ... 100000	*	rpm	
158-MOCNM	Rated motor current	*	*	A	
159-MOCOS	Nominal cosφ motor	0 ... 1	1		
160-MOJNM	Mass moment of inertia of motor	0 ... 100	see Table 5.5		
161-SCJ1	CDS1: Mass moment of inertia of system	0 ... 1000	0		
162-SCJ2	CDS2: Mass moment of inertia of system	0 ... 1000	0		
163-ENSC	Enable auto-tuning	STOP/START	STOP		
164-UDSWR	Back-up device setup in a user data set	1 ... 4	1		✔
165-UDSAC	Activate user data set	1 ... 4	1		
166-UDSSL	Control location for switchover of the active user data set	see Table 5.17	PARAM		✔
167-SCPRO	Auto-tuning progress indicator	0 ... 100	0	%	
300-CFCON	Current open-loop/closed-loop control mode of the device	see Table 5.10	VFC		

Table 5.1 *Parameters of subject area* "_15FC-Initial commissioning"

Explanatory notes

- Parameter values resulting from the size of the current inverter module are assigned an asterisk (*) in the "Value range" and "Factory setting" columns.

Backing-up the device setup (150-SAVE)

With the setting 150-SAVE = START the device setup is stored in the active user data set.

During the save operation the parameter value START is displayed; it does not switch to STOP until the operation has been completed successfully.

The same effect is achieved by simultaneously pressing the two cursor keys on the KEYPAD KP200 control unit for approx. 2 seconds while at the menu level. At the menu level the display shows "MENU".

Setting application data set (152-ASTER)

Selection of the application data set defines the framework parameters of the predefined application solutions. This special adaptation to different preset solutions is made with parameter 152-ASTER.

When a parameter of an application data set is changed, the assistance parameter 152-ASTER is automatically set to OFF. Parameter 151-ASTPR for the active application data set retains its setting.

BUS	0	1	2	3	4	5	6	7	8	9	
KP/DM	OFF	DRV_1	DRV_2	DRV_3	DRV_4	DRV_5	ROT_1	ROT_2	ROT_3	BUS_1	
BUS	10	11	12	13	14	15	16	17	18	19	20
KP/DM	BUS_2	BUS_3	M-S_1	M-S_2	M-S_3	M-S_4	ROT_4	ROT_5	ROT_6	BUS_4	BUS_5

Table 5.2 Settings for selection of the application data sets

For explanatory notes on assistance parameter 152-ASTER refer to section 4 "Application data sets".

Note: Select a suitable application data set before setting the inverter parameters for your application. Selecting the application data set later will overwrite your parameter setting with the fixed presets of the application data set concerned. The only exceptions are the auto-tuning parameters.

Input of motor data

The motor data are read from the motor rating plate, depending on circuit type and frequency inverter, and entered in the parameters.

Motor connection of an IEC standard motor (230/400 V, Δ/Y)

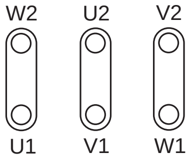
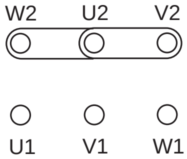
Frequency inverter	Rated voltage/ circuit type	Motor terminal block
CDA 32.xxx	3 x 230 V/Δ	
CDA 34.xxx	3 x 400 V/Y	

Table 5.3 Connection of a 3 x 230 / 400 V standard motor as per IEC 34

Note: When using special three-phase AC motors not conforming to IEC 34, obtain information on the type of termination from the motor manufacturers.

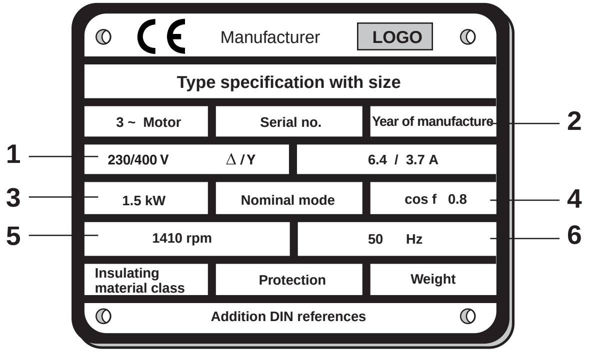


Figure 5.7 Motor rating plate

No.	Function	Parameter	Setting
1	Rated voltage of motor in circuit type Δ → 230 V Y → 400 V	155-MOVNM	Δ: 230 V Y: 400 V
2	Rated current of motor in circuit type Δ → 6.4A Y → 3.7A	158-MOCNM	Δ: 6.4 A Y: 3.7 A
3	Rated power of motor	154-MOPNM	1.5 kW
4	Power factor cos f of motor	159-MOCOS	0.8
5	Rated speed of motor	157-MOSNM	1410 rpm
6	Rated frequency of motor	156-MOFN	50 Hz

Table 5.4 Motor rating plate data

Setting motor mass moment of inertia (160-MOJNM)

The mass moment of inertia of the motor must be entered under parameter 160-MOJNM in order to ensure optimum running in control mode SFC/FOR.

If no mass moment of inertia is entered (160-MOJNM=0), a mass moment of inertia matching an IEC standard motor is defined based on the motor data.

The basis is provided by the table presented below for a six-pole asynchronous motor.

The mass moment of inertia of the motor is dependent on the number of pole pairs and the related rotor design. Consequently, the table values are adjusted according to the number of pole pairs.

Mass moments of inertia of standard three-phase a.c. motors with squirrel-cage rotor to DIN VDE 0530, 1000 rpm, 6-pole, 50 Hz and internally cooled, stored in the CDA3000:

Power P [kW]	Mass moment of inertia J_M [kgm²]
0.09	0.00031
0.12	0.00042
0.18	0.00042
0.25	0.0012
0.37	0.0022
0.55	0.0028
0.75	0.0037
1.1	0.0050
1.5	0.010
2.2	0.018
3.0	0.031
4.0	0.038
5.5	0.045
7.5	0.093
11	0.127
13	0.168
15	0.192
20	0.281
22	0.324
30	0.736
37	1.01
45	1.48
55	1.78
75	2.36
90	3.08

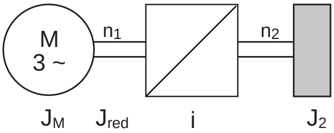
Table 5.5 Base values for the mass moment of inertia referred to a six-pole IEC standard motor

Setting of mass moment of inertia of system (160-SCJ1, 162-SCJ2)

The mass moment of inertia of the system must be entered under parameters 160-SCJ1 (CDS1) and 162-SCJ2 (CDS2) in order to ensure optimum running in control mode SFC/FOR.

If no mass moment of inertia is entered for the system, a 1:1 adjustment of the mass moment of inertia is assumed and the mass moment of inertia of the system is set equal to that of the motor.

Reduction of the mass moment of inertia of the system



$$J_{red} = \frac{J_2}{i^2} = \frac{J_2}{\left(\frac{n_1}{n_2}\right)^2}$$

J_M = Mass moment of inertia: of motor (MOJNM)
J_{red} = Reduced mass moment of inertia of the system (SCJx)
i Gear transmission ratio factor

Figure 5.8 Reduction of mass moment of inertia

Note: Above a ratio of 1:5 ($J_M : J_{red}$) the mass moment of inertia of the application must be specified, otherwise the control response will not be stable.

Note: Specification of the mass moments of inertia is of significance for control modes SFC and FOR. The speed controller is set on the basis of the mass moments of inertia during auto-tuning (see section 6.2 "Sensorless Flux Control" and 6.3 "Field Oriented Regulation").

Activation of auto-tuning (163-ENSC)

Before activating auto-tuning it is essential to enter the motor rating plate data. Likewise the reduced mass moment of inertia of the system and the mass moment of inertia of the motor must also be entered beforehand, if known.

Necessity for auto-tuning

Open-loop or closed-loop control mode	Auto-tuning necessary?
VFC	Motor power output < inverter power output **and** application of one of the following functions: • Current injection • Magnetization • DC braking • DC holding • Slip compensation • IxR load compensation • Up synchronization • Motor holding brake
SFC	Auto-tuning should always be performed in the initial commissioning phase.
FOR	

Table 5.6 Conditions for auto-tuning

Successful auto-tuning requires that the motor power output be less than the inverter output.

Note: During auto-tuning the motor circuit must be closed. Accordingly, contactors should only be jumpered during the auto-tuning phase.
If the motor contactor is activated via the inverter module by the ENMO function, the motor contactor is automatically closed during auto-tuning (see section 5.2.4 "_24OD-Digital outputs").

The START value of parameter 163-ENSC activates auto-tuning of the inverter module. Auto-tuning identifies the motor and its characteristic values are automatically entered in the "Motor data" subject area. Additionally, all controller parameters are set up for the motor.

During auto-tuning the parameter value START is displayed; it does not switch to STOP until auto-tuning has been completed successfully. A percentage progress indicator (0-100%) is additionally displayed by way of parameter 167 -SCPRO.

Attention! In the final auto-tuning phase the values obtained are **not** automatically stored in the active user data set.
As from DRIVEMANAGER V3.0 the current data set can be stored in the user data set on completion of screen-guided initial commissioning with auto-tuning.

The parameter data set is stored by way of 150-SAVE=START in the current user data set or directly by parameter 164-UDSWR in a different user data set.

Parameters written to during auto-tuning of the device are retained when a new application data set is selected. Switching user data set does overwrite the auto-tuning parameters, however. The auto-tuning should therefore be performed before parameter setting of the user data sets (UDS).

Auto-tuning parameters		**Used in control mode**		
		VFC	**SFC**	**FOR**
_15FC Initial commissioning, section 5.1				
160-MOJNM	Mass moment of inertia of motor		✔	✔
161-SCJ1	CDS1: Mass moment of inertia of system		✔	✔
162-SCJ2	CDS2: Mass moment of inertia of system		✔	✔
_31MB Motor holding brake				
313-SSCW	BRK2: Frequency limit for motor holding brake (clockwise)	✔	✔	
314-SSCCW	BRK2: Frequency limit for motor holding brake (anti-clockwise)	✔	✔	
315-SSHYS	BRK2: Frequency hysteresis for motor brake	✔	✔	
_33MO Motor protection				
335-MOPCN	Rated motor current for motor protection	✔	✔	✔
336-MOPFN	Rated motor frequency for motor protection	✔	✔	✔
_63FS Up synchronization				
631-FSFMX	Maximum frequency during searching in up synchronization	✔		
632-FSRMP	Ramp during searching in up synchronization	✔		
634-FSOND	Demagnetization time in up synchronization	✔		
636-FSVFD	Transition time to normal mode in up synchronization	✔		

Table 5.7 Parameters changed during auto-tuning

Auto-tuning parameters		Used in control mode VFC	SFC	FOR
_64CA Current-controlled startup				
641-CLCL1	CDS1: Current limit value, current-controlled startup	✔	✔	
642-CLFL2	CDS1: Lowering frequency, current-controlled startup	✔	✔	
643-CLFR1	CDS1: Initial frequency, current-controlled startup	✔	✔	
646-CLCL2	CDS2: Current limit value, current-controlled startup	✔	✔	
647-CLFL2	CDS2: Lowering frequency, current-controlled startup	✔	✔	
648-CLFR2	CDS2: Initial frequency, current-controlled startup	✔	✔	
_70VF V/F characteristic, section 6.1.1				
700-VB1	CDS1: Boost voltage	✔		
701-VN1	CDS1: Rated motor voltage	✔		
702-FN1	CDS1: Rated motor frequency	✔		
715-VB2	CDS2: Boost voltage	✔		
716-VN2	CDS2: Rated motor voltage	✔		
717-FN2	CDS2: Rated motor frequency	✔		
_74IR IxR load compensation, section 6.1.2				
741-KIXR1	CDS1: IxR correction factor	✔		
743-KIXR2	CDS2: IxR correction factor	✔		
_75SL Slip compensation, section 6.1.3				
751-KSC1	CDS1: Slip compensation factor	✔		
753-KSC2	CDS2: Slip compensation factor	✔		
_76CI Current injection, section 6.1.4 (as from firmware V1.4)				
760-CICN1	CDS1: Current injection reference 1	✔		
763-CICN2	CDS2: Current injection reference value	✔		
_77MP Magnetizing, section 5.5.14				
770-MPCN1	CDS1: Magnetizing current	✔	✔	✔
772-MPCN2	CDS2: Magnetizing current	✔	✔	✔
774-MPT	Magnetization time for SFC and FOR		✔	✔
_78SS Speed controller SFC, section 6.2.1				
780-SSGF1	CDS1: Scaling of speed controller gain		✔	
781-SSG1	CDS1: Controller gain of encoder		✔	

Table 5.7 Parameters changed during auto-tuning

Auto-tuning parameters		Used in control mode		
		VFC	SFC	FOR
782-SSTL1	CDS1: Speed controller lag time		✔	
783-SSTF1	CDS1: Filter time constant of speed estimate		✔	
784-SSGF2	CDS2: Scaling of speed controller gain		✔	
785-SSG2	CDS2: Controller gain of encoder		✔	
786-SSTL2	CDS2: Speed controller lag time		✔	
787-SSTF2	CDS2: Filter time constant of speed estimate		✔	
_80CC Current control, section 6.3.3				
800-CCG	Current controller gain	✔	✔	✔
801_CCTLG	Current controller lag time	✔	✔	✔
802-CCTF	Filter time constant for current measurement	✔	✔	
803-VCSFC	Correction factor of fault voltage characteristic SFC		✔	✔
804-CLIM1	CDS1: Maximum reference current for current control	✔	✔	✔
805-CLIM2	CDS2: Maximum reference current for current control	✔	✔	✔
_81CC Speed controller FOR, section 6.3.2				
810-SCGF1	CDS1: Scaling of speed controller gain			✔
811-SCG1	CDS1: Speed controller gain			✔
812-SCTL1	CDS1: Speed controller lag time			✔
813-SCTF1	CDS1: Jitter filter time constant			✔
814-SCGF1	CDS2: Scaling of speed controller gain			✔
815-SCG1	CDS2: Speed controller gain			✔
816-SCTL1	CDS2: Speed controller lag time			✔
817-SCTF1	CDS2: Jitter filter time constant			✔
818-SCGF0	Speed controller gain at frequency zero			✔
_84 MD Motor data, section 5.5.13				
840-MOFNM	Nominal pole flux		✔	✔
841-MOL_S	Leakage inductance		✔	✔
842-MOR_S	Stator resistance		✔	✔
843-MOR_R	Rotor resistance		✔	✔
844-MONPP	Number of pole pairs of motor		✔	✔

Table 5.7 Parameters changed during auto-tuning

Storing a user data set (UDS) (164-UDSWR)

Customer/user settings are stored in one of the four possible user data sets.

The user data set is selected by way of parameter 164-UDSWR and then the parameter settings in the RAM are stored as a complete user data set.

Note: Parameter 150-SAVE only ever saves the active data set to the current user data set.

Switching between UDS (165-UDSAC, 166-UDSSL)

A user data set can be activated by way of parameter 165-UDSAC. The active user data set is displayed as the parameter value.

The control location for activation of a user data set is defined with parameter 166-UDSSL.

Settings with 166-UDSSL for switchover of the active user data set

BUS	KP/DM	Function
0	PARAM	Switchover by direct editing of the parameter
1	TERM	Switchover by input with function selector setting UM0 (significance 2^0) or UM1 (significance 2^1)
2	SIO	Switchover by SIO control word (RS 232 port)
3	OPTN1	Switchover by control word of option module to slot 1
4	OPTN2	Switchover by control word of option module to slot 2

Table 5.8 Settings for switchover of the active user data set

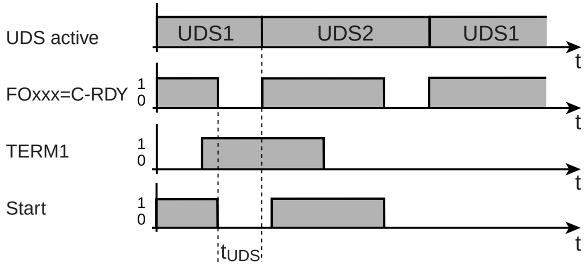
User data sets cannot be switched "online". The hardware enable via the "ENPO" signal may still be applied, but the inverter module power stage must be inactive. This means no start signal must be present in the switchover phase.

Example of switchover by terminal operation (166-UDSSL = TERM)

Terminal 1	Terminal 2	User data set
0	0	User data set 1 001 MODE ⋮ 999 xyz
1	0	User data set 2 001 MODE ⋮ 999 xyz
0	1	User data set 3 001 MODE ⋮ 999 xyz
1	1	User data set 4 001 MODE ⋮ 999 xyz

Table 5.9 Example of selection of user data sets via terminals

A UDS switchover takes several seconds, depending on the number of internal parameters to be changed. The UDS switchover can be monitored by setting the parameters of a digital output (section 5.2.4 "_24OD-Digital outputs") by way of its function selector. For this, the relevant function selector must be set to "C-RDY".



FOxxx Function selector of a digital output
TERM1 UDS switchover via a digital input
Start Start enable via STR/STL
t_{UDS} Internal device time for parameter switch to a new UDS

Figure 5.9 UDS switchover

For more information on the data structure see section 3.1.

Current open-loop/closed-loop control modes with 300-CFCON

BUS	KP/DM	Function	Reference
0	VFC	Controlled operation based on an adjustable V/F characteristic	Section 6.1
1	SFC	Sensorless flux control with overlaid current control	Section 6.2
2	FOR	Encoder-controlled speed control (Field-Oriented Regulation)	Section 6.3

Table 5.10 Setting of the current open-loop/closed-loop control mode

Note: Control modes SFC and FOR only work with an asynchronous motor. Control mode VFC additionally supports synchronous and reluctance motors.

5.2 Inputs and outputs

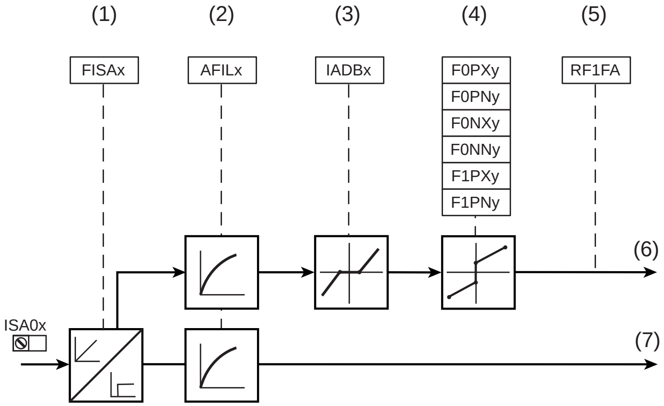
Each input and output of the inverter module has a parameter which assigns it a function. These parameters are termed "function selectors" and are located in the relevant subject areas of the inputs and outputs.

The reference structure and the control location additionally have an influence on the function of the inputs and outputs. Presets are already entered in the application data sets.

For information on the hardware of the inputs and outputs refer to section 2.4 "Specification of control connections" and the Operation Manual.

5.2.1 _18IA-Analog inputs

Function	Effect
• Definition of the internal processing of the analog input signals	• Conditioning and filtering of the analog reference input or use as a digital input



(1) Analog reference input or use as a digital input
(2) Input filter for fault isolation from 0 to 21 s
(3) Backlash function for fault isolation around zero
(4) Scaling of the analog input
(5) Scaling factor [%], see section 5.2.6 "_28RS-Reference structure"
(6) Analog value
(7) Digital value
x Number of the input
y Number of the characteristic data set (CDS)

Figure 5.10 Function block for adaptation of the analog inputs

Configuration options, ISA0x

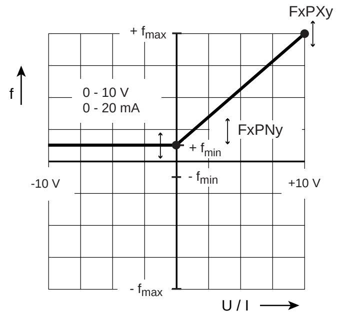


Figure 5.11 Scaling in unipolar operation

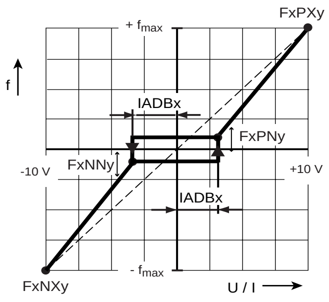
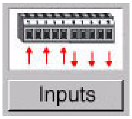


Figure 5.12 Backlash function in bipolar operation

1.



2.

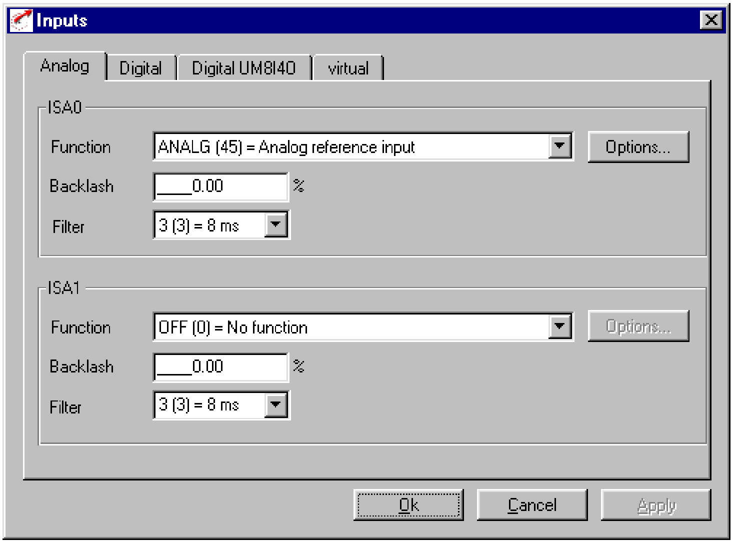


Figure 5.13 "Analog inputs" tab

3.

The Options screens are selected depending on the "Function" setting.

Parameters for analog inputs ISA0x

Parameter	Function	Value range	FS	Unit	Online
180-FISA0	Function selector analog standard input ISA00	see Table 5.12	OFF		
181-FISA1	Function selector analog standard input ISA01	see Table 5.12	OFF		
182-F0PX1	CDS1: Maximum value ISA00 at +10V	-1600 ... 1600	50	Hz	
183-F0PN1	CDS1: Minimum value ISA00 at +0V	-1600 ... 1600	0	Hz	
184-F0NX1	CDS1: Maximum value ISA00 at -10V	-1600 ... 1600	0	Hz	
185-F0NN1	CDS1: Minimum value ISA00 at -0V	-1600 ... 1600	0	Hz	
186-F1PX1	CDS1: Maximum value ISA01 at +10V	-1600 ... 1600	50	Hz	
187-F1PN1	CDS1: Minimum value ISA01 at +0V	-1600 ... 1600	0	Hz	
188-AFIL0	Filter time constant for analog channel ISA00	see Table 5.14	3		✔
189-AFIL1	Filter time constant for analog channel ISA01	see Table 5.14	3		✔
190-F0PX2	CDS2: Maximum value ISA00 at +10V	-1600 ... 1600	50	Hz	
191-F0PN2	CDS2: Minimum value ISA00 at +0V	-1600 ... 1600	0	Hz	
194-F0NX2	CDS2: Maximum value ISA00 at -10V	-1600 ... 1600	0	Hz	
195-F0NN2	CDS2: Minimum value ISA00 at -0V	-1600 ... 1600	0	Hz	
196-F1PX2	CDS2: Maximum value ISA01 at +10V	-1600 ... 1600	50	Hz	
197-F1PN2	CDS2: Minimum value ISA01 at +0V	-1600 ... 1600	0	Hz	
192-IADB0	ISA00 play range	0 ... 90	0,00	% [1]	
193-IADB1	ISA01 play range	0 ... 90	0,00	% [1]	

[1] Referred to 10 V

Table 5.11 Parameters from subject area "_18IA-Analog inputs"

Settings for 180-FISA0 and 181-FISA1 analog inputs

BUS	KP/DM	Function	Effect
0	OFF	No function	Input off
1	STR	Start clockwise	Start enable for motor clockwise running
2	STL	Start anti-clockwise	Start enable for motor anti-clockwise running
3	INV	Reverse direction	Reference is inverted, causing a reversal of direction
4	/STOP	/Emergency stop	Stop ramp is executed dependent on active characteristic data set (CDS). ATTENTION: Signal inverted (/) (section 5.5.3 "_59DP-Driving profile generator")
5	SADD1	Offset for reference selector 280-RSSL1	Reference selector 280-RSSL1 is offset by the value in 289-SADD1 to a different reference source (section 5.2.6 "_28RS-Reference structure").
6	SADD2	Offset for reference selector 281-RSSL2	Reference selector 281-RSSL2 is offset by the value in 290-SADD2 to a different reference source (section 5.2.6 "_28RS-Reference structure").
7	E-EXT	External error	Error messages from external devices produce a fault signal with response as defined in parameter 524-R-EXT (section 5.3.10 "_51ER-Error messages").
8	RSERR	Reset error message	Error messages are reset if the error is no longer present.
9	MP-UP	MOP, increase reference value	Reference of digital MOP function is increased (section 5.5.2 "_32MP-MOP function").
10	MP-DN	MOP, reduce reference	Reference value of digital MOP function is reduced (section 5.5.2 "_32MP-MOP function").
11	CUSEL	Select characteristic data set (CDS)	Switch characteristic data set (CDS) 0 = CDS1, 1 = CDS2 (section 5.5.6 "_65CS-Characteristic data switchover (CDS)").
12	FFTB0	Driving set selection (significance 2^0)	Binary driving set selection (bit 0), frequency with acceleration and deceleration ramp (section 5.5.5 "_60TB-Driving sets").
13	FFTB1	Driving set selection (significance 2^1)	Binary driving set selection (bit 1), fixed frequency with acceleration and deceleration ramp (section 5.5.5 "_60TB-Driving sets").
14	FFTB2	Driving set selection (significance 2^2)	Binary driving set selection (bit 2), fixed frequency with acceleration and deceleration ramp (section 5.5.5 "_60TB-Driving sets").

Table 5.12 Settings for analog inputs

1 2 3 4 5 6 A
DE EN

BUS	KP/DM	Function	Effect
15	UM0	User data set (UDS) switchover, (significance 2^0)	Binary data set selection (bit 0) (section 5.1 "_15FC-Initial commissioning").
16	UM1	User data set (UDS) switchover, (significance 2^1)	Binary data set selection (bit 1) (section 5.1 "_15FC-Initial commissioning").
17	/LCW	Limit switch clockwise	Response to error message in case of reversed limit switches as defined in parameter 534-R-LSW (section 5.3.10 "_51ER-Error messages").
18	/LCCW	Limit switch clockwise	Response to error message in case of reversed limit switches as defined in parameter 534-R-LSW (section 5.3.10 "_51ER-Error messages").
19	SIO	Input appears in status word of serial interface (terminal X4)	Status of input readable via status word parameter 550-SSTAT of LUST-BUS (section 5.4.1 "_55LB-LustBus").
20	OPTN1	Reserved for option module at slot 1	Input is available to option module at slot 1, usable only in conjunction with communication modules
21	OPTN2	Reserved for option module at slot 2	Input is available to option module at slot 2, usable only in conjunction with communication modules
22	USER0	Reserved for modified software	Input can be used by modified software
23	USER1	Reserved for modified software	Input can be used by modified software
24	USER2	Reserved for modified software	Input can be used by modified software
25	USER3	Reserved for modified software	Input can be used by modified software
26	MAN	Manual mode activation in field bus operation	An inverter module configured for bus operation can be switched to manual mode (e.g. setup or emergency operation mode)
29	0-10V	Analog reference input 0-10 V	Reference input 0-10 V. Pay attention to scaling and adapt reference structure by means of reference selector (section 5.2.6 "_28RS-Reference structure").
30	SCALE	Limitation of motor current	The current limit value CLIM1/2 for SFC and FOR is limited and thus also the maximum torque (section 5.5.10 "_80CC-Current controller").

Table 5.12 Settings for analog inputs

BUS	KP/DM	Function	Effect
31	PM10V	Voltage input -10 V ... +10 V	Reference input 0-10 V. Pay attention to scaling and adapt reference structure by means of reference selector (section 5.2.6 "_28RS-Reference structure").
32	0-20	Current input 0 ... 20 mA	
33	4-20	Current input 4 ... 20 mA	If the current falls below 4 mA, the wire-break monitor is tripped. Response to error message is defined by way of parameter 529 -R-WBK (section 5.3.10 5.3.10 "_51ER-Error messages").

Table 5.12 Settings for analog inputs

Explanatory notes

- The settings STR to MAN of the function selectors evaluate the input as a digital input (24V digital input).
- Wire-break monitoring: When 4-20 mA is set, the system state monitor triggers an error as soon as the current at the input (ISA00 only) falls below 3 mA (for error message see Appendix)..
- For characteristic switchover via CUSEL, the control location for the switchover must be set in parameter 651-CDSSL to TERM (terminal operation).
- The "MAN" function permits a device configured for bus operation to be operated by the operator locally. This function can be used for system setup or emergency operation mode.
  By the "MAN" function the parameters are automatically assigned new parameter values, as set out in Table 5.13. This is also done while the power stage is active - that is, online.
  To do so, the drive is stopped and the control location is placed at the manual operation point (Term). A restart can only be executed from the "TERM" control location when the 0 Hz reference has been reached. An active auto-start is only suppressed on switchover to control location "TERM".

Action	Function	Parameter
Control location	Terminals	260-CLSEL = TERM
Input ISD00	Start clockwise	210-FIS00 = STR
Input ISD01	Start anti-clockwise	211-FIS01 = STL
Reference channel 1	Analog input 0	276-RSSL1 = FA0
Reference channel 2	Off	277-RSSL2 = FCON

Table 5.13 Online changes based on activation of the input with the MAN function

Note: While the "MAN" function is active, the settings must not be saved in the device, as the reference structure is changed in the background and the "MAN" function would be activated after the next power-on.

- When the analog inputs are operated digitally, the static signal at the terminal is evaluated (see section 2.4 "Specification of control connections"). It should be noted in this that the filter time constant (parameter 188-AFIL0 and 169-AFIL1) will cause a delay in the response time. If this is not wanted, for example when the inputs are assigned the limit switch evaluation function, parameters 188-AFIL0 and 189-AFIL1 must be set to 0.

When the analog input is used as a digital input, the notes regarding the isolation concept must be observed (see section 2.6).

The response of the CDA3000 inverter module to the reference value 0Hz can be set in the driving profile generator subject area by parameter 597-RF0.

Settings for 188-AFIL0 and 189-AFIL1 filter time constant for analog channels

Value	Filter time [ms]	Value	Filter time [ms]
0	Off	16	3707
1	2	17	4425
2	4	18	5207
3	8	19	6053
4	16	20	6962
5	32	21	7935
6	64	22	8971
7	102	23	10071
8	248	24	11235
9	458	25	12462
10	732	26	13752
11	1068	27	15107
12	1469	28	16524
13	1933	29	18006
14	2461	30	19551
15	3052	31	21159

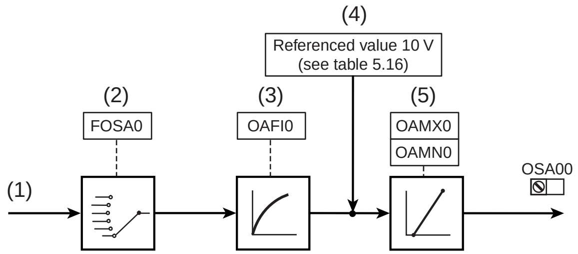
Table 5.14 Setting of filter time constants

5.2.2 _200A-Analog output

Function	Effect
• Definition of which scaled actual value is delivered at the analog output (0 ... 10 V)	• Conditioning and filtering of the analog actual value • The analog output provides diagnosis by way of a volt-meter if no DRIVEMANAGER with digital scope is available.

Designation on tab	Setting	Programmable values	Stored in
Function		see Table 5.16	
Filter		see Table 5.16	
0V corresponds to		see Table 5.16	
10V corresponds to		see Table 5.16	

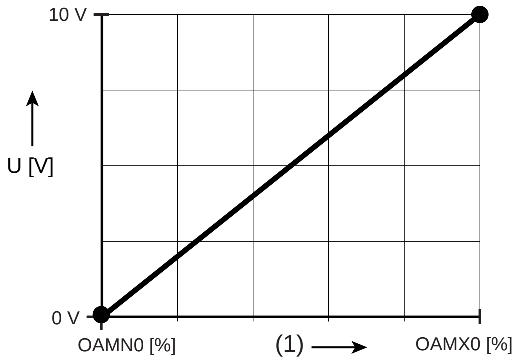
Table 5.15 Key to Figure 5.16



(1) Actual
(2) Selection of the analog actual value
(3) Output filter for fault isolation from 0 to 64 ms
(4) Referenced value 10 V
(5) Scaling of the analog output

Figure 5.14 Function block for adaptation of the analog output

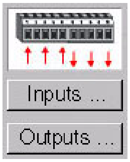
Configuration options, OSA00



(1) Output variable, e.g. frequency

Figure 5.15 Scaling of the analog output

1.



2.

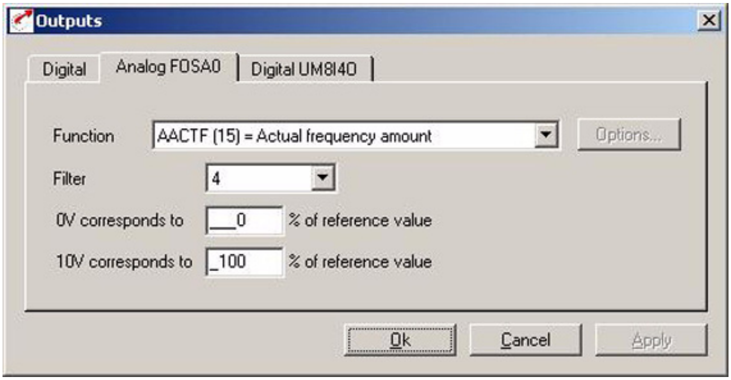


Figure 5.16 "Analog outputs" tab

3.

Optionen...

The Options screens are selected depending on the "Function" setting.

Parameters for analog output

Parameter	Function	Value range	FS	Unit	Online
200-FOSA0	Function selector analog standard output OSA00	see Table 5.17	ACTF		
201-OAMN0	Minimum value for analog output OSA00	-200 ... 200	0	%	
202-OAMX0	Maximum value for analog output OSA00	-200 ... 200	100	%	
203-OAFI0	Filter time constant for analog channel OSA00	(2^xms), x = 0 ... 6	4		
204-TSCL	Torque scaling value	0.5 ... 2040	see Table 5.18	Nm	

Table 5.16 Parameters from subject area _20OA Analog output

Explanatory notes

- For the two corner points (0 V, 10 V) the actual value can be adapted from a reference value in the range from - 200 % to + 200 %.

Settings for 200-FOSA0 analog output

BUS	KP/DM	Function	Effect/Notes	Referenced value 10 V
0	OFF	No function	Output off	
1	ACTF	Current actual frequency	Clockwise only (positive values only) Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Control mode VFC: display of reference frequency	FMAX1/2
2	ACTN	Current actual speed	Only only (positive values only) Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Control mode VFC: no display	FMAXx * 60 / number of pole pairs
3	APCUR	Current apparent current		$2*I_N$
4	ACCUR	Current effective current		$2*I_N$
5	ISA0	Voltage or current at analog input ISA00		10 V / 20 mA
6	ISA1	Voltage at analog input ISA01		10 V

Table 5.17 Settings for analog output

BUS	KP/DM	Function	Effect/Notes	Referenced value 10 V
7	MTEMP	Current motor temperature	Motor temperature only with linear evaluation (PTC)	200 °C
8	KTEMP	Current heat sink temperature	$\leq$ 15 kW: Temperatures > 100 °C in the power stage module correspond to temperatures > 85 °C on the heat sink and result in a shut-off $\geq$ 15 kW: Temperatures > 85 °C result in a shut-off, because the temperature sensor is mounted directly on the heat sink.	200 °C
9	DTEMP	Current interior temperature	Interior temperatures > 85 °C result in a shut-off	200 °C
10	DCV	DC-link voltage	Referenced values dependent on device version CDA32.xxx 500 V CDA34.xxx 1000 V	500 V / 1000 V
11	VMOT	Motor voltage	Referenced values dependent on device version CDA32.xxx 500 V CDA34.xxx 1000 V	500 V / 1000 V
12	PS	Apparent power		$2*P_N$
13	PW	Effective power		$2*P_N$
14	ACTT	Current actual torque	Control mode FOR: true actual torque Control mode SFC: estimated actual torque Control mode VFC: no display	Dependent on device, see Table 5.18
15	AACTF	Amount of current actual frequency	Clockwise (pos. value) and anti-clockwise (neg. value) are represented as amounts. Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Control mode VFC: display of reference frequency	FMAX1/2
16	AACTN	Amount of current actual speed	Clockwise (pos. value) and anti-clockwise (neg. value) are represented as amounts. Control mode FOR: true actual speed Control mode SFC: estimated actual speed Control mode VFC: no display	FMAXx * 60 / number of pole pairs

Table 5.17 Settings for analog output

Device-dependent torques for scaling (204-TSCL)

Device type	Power output [kW]	Torque for scaling	
		Value range for 204-TSCL	Referenced value 10 V [Nm]
CDA32.003	0.375	0.5 ... 2040 Nm	5
CDA32.004	0.75		10.2
CDA32.006	1.1		15
CDA32.008	1.5		20
CDA34.003	0.75		10.2
CDA34.005	1.5		20
CDA34.006	2.2		30
CDA34.008	3		40
CDA34.010	4		54
CDA34.014	5.5		72
CDA34.017	7.5		98
CDA34.024	11		144
CDA34.032	15		196
CDA34.045	22		288
CDA34.060	30		392
CDA34.072	37		480
CDA34.090	45		584
CDA34.110	55		712
CDA34.143	75		968
CDA34.170	90		1162

Table 5.18 Torque scaling values for different device power classes in SFC and FOR

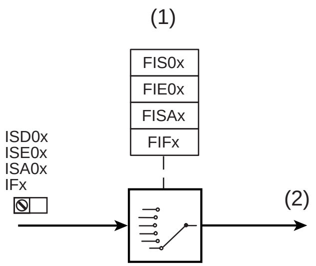
Setting for 203-OAFI0 Filter constant for analog output OSA00

Value	Filter time [ms]
0	Off
1	2
2	4
3	8
4	16
5	32
6	64

Table 5.19 Setting of filter time constants

5.2.3 _21ID-Digital inputs

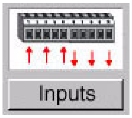
Function	Effect
• The function selectors determine the function of the digital inputs.	• Free function assignment of all digital inputs



(1) Selection of function of digital input
(2) Digital value

Figure 5.17 Function block for adaptation of the digital inputs

1.



2.

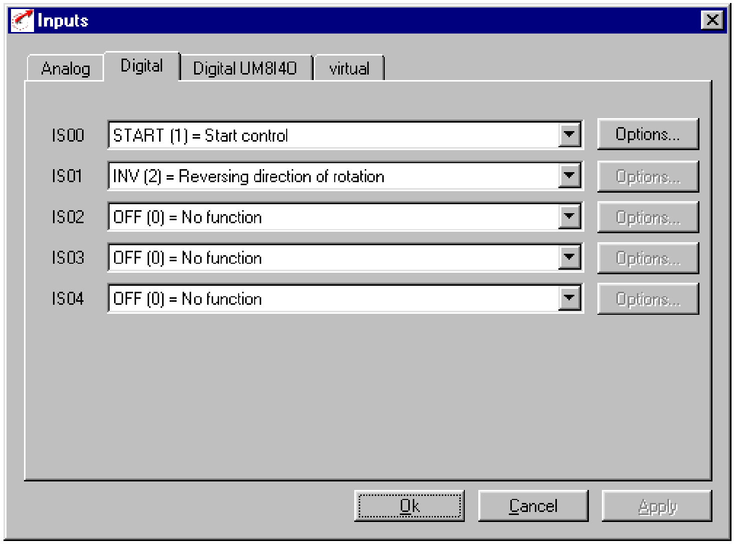


Figure 5.18 "Digital inputs" tab

3.

The Options screens are selected depending on the "Function" setting.

Parameters for digital inputs

Parameter	Function	Value range	FS	Unit	Online
210-FIS00	Function selector digital standard input ISD00	see Table 5.21	STR		✔
211-FIS01	Function selector digital standard input ISD01	-“-	STL		✔
212-FIS02	Function selector digital standard input ISD02	-“-	SADD-1		✔
213-FIS03	Function selector digital standard input ISD03	-“-	OFF		✔
214-FIE00	Function selector digital input of user module IED00	-“-	OFF		✔
215-FIE01	Function selector digital input of user module IED01	-“-	OFF		✔
216-FIE02	Function selector digital input of user module IED02	-“-	OFF		✔
217-FIE03	Function selector digital input of user module IED03	-“-	OFF		✔
218-FIE04	Function selector digital input of user module IED04	-“-	OFF		✔
219-FIE05	Function selector digital input of user module IED05	-“-	OFF		✔
220-FIE06	Function selector digital input of user module IED06	-“-	OFF		✔
221-FIE07	Function selector digital input of user module IED07	-“-	OFF		✔
222-FIF0	Function selector virtual digital fixed input 0	-“-	OFF		✔
223-FIF1	Function selector virtual digital fixed input 1	-“-	OFF		✔

1) Switch between FMSI and simple input functions does not work online

Table 5.20 Parameters from subject area _21ID Digital inputs

Explanatory notes

- The analog inputs ISA00 and ISA01 can also be assigned digital functions (see section 5.2.1).
- Selectors FIF0 and FIF1 provide two virtual inputs with the fixed value 1 (High level). They can be used in place of a permanently active switch.

Settings for FIS00 ... 214-FIE00 ... 223-FIF1

BUS	KP/DM	Function	Effect	FIS00	FIS01	FIS02	FIS03	FIE0x	FIFx
0	OFF	No function	Input off	✔	✔	✔	✔	✔	✔
1	STR	Start clockwise	Start enable for motor clockwise running	✔	✔	✔	✔	✔	✔
2	STL	Start anti-clockwise	Start enable for motor anti-clockwise running	✔	✔	✔	✔	✔	✔
3	INV	Reverse direction	Reference is inverted, causing a reversal of direction	✔	✔	✔	✔	✔	✔
4	/STOP	/Emergency stop via stop ramp	Stop ramp is executed dependent on active characteristic data set (CDS). **ATTENTION:** Signal inverted (/) (section 5.5.3 "_59DP-Driving profile generator")	✔	✔	✔	✔	✔	✔
5	SADD1	Offset for reference selector 280-RSSL1	Reference selector 280-RSSL1 is offset by the value in 289-SADD1 to a different reference source. (section 5.2.6 "_28RS-Reference structure")	✔	✔	✔	✔	✔	✔
6	SADD2	Offset for reference selector 281-RSSL2	Reference selector 281-RSSL2 is offset by the value in 290-SADD2 to a different reference source. (section 5.2.6 "_28RS-Reference structure")	✔	✔	✔	✔	✔	✔
7	E-EXT	External error in another device	Error messages from external devices produce a fault signal with response as defined in parameter 524-R-EXT. (section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔	✔	
8	RSERR	Reset error message	Error messages are reset if the error is no longer present.	✔	✔	✔	✔	✔	
9	MP-UP	MOP, increase reference value	Reference value of digital MOP function is increased. (section 5.5.2 "_32MP-MOP function")	✔	✔	✔	✔	✔	
10	MP-DN	MOP, reduce reference value	Reference value of digital MOP function is reduced. (section 5.5.2 "_32MP-MOP function")	✔	✔	✔	✔	✔	
11	CUSEL	Select characteristic data set (CDS)	Switch characteristic data set (CDS) 0 = CDS1, 1 = CDS2 (section 5.5.6 "_65CS-Characteristic data switchover (CDS)")	✔	✔	✔	✔	✔	

Table 5.21 Settings of the function selectors

BUS	KP/DM	Function	Effect	FIS00	FIS01	FIS02	FIS03	FIE0x	FIFx
12	FFTB0	Driving set selection (significance 2^0)	Binary driving set selection (bit 0), fixed frequency with acceleration and deceleration ramp. (section 5.5.5 "_60TB-Driving sets")	✔	✔	✔	✔	✔	
13	FFTB1	Driving set selection (significance 2^1)	Binary driving set selection (bit 1), fixed frequency with acceleration and deceleration ramp. (section 5.5.5 "_60TB-Driving sets")	✔	✔	✔	✔	✔	
14	FFTB2	Driving set selection (significance 2^2)	Binary driving set selection (bit 2), fixed frequency with acceleration and deceleration ramp. (section 5.5.5 "_60TB-Driving sets")	✔	✔	✔	✔	✔	
15	UM0	User data set (UDS) switchover, (significance 2^0)	Binary data set selection (bit 0) (section 5.1 "_15FC-Initial commissioning")	✔	✔	✔	✔	✔	
16	UM1	User data set (UDS) switchover, (significance 2^1)	Binary data set selection (bit 1) (section 5.1 "_15FC-Initial commissioning")	✔	✔	✔	✔	✔	
17	/LCW	Limit switch clockwise	Limit switch evaluation without override protection. Response to error message in case of reversed limit switches as defined in parameter 534-R-LSW. (section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔	✔	
18	/LCCW	Limit switch anti-clockwise	Limit switch evaluation without override protection. Response to error message in case of reversed limit switches as defined in parameter 534-R-LSW. (section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔	✔	
19	SIO	Input appears in status word of serial interface (terminal X4)	Status of input readable via status word parameter 550-SSTAT of LUSTBUS (section 5.4.1 "_55LB-LUSTBUS")	✔	✔	✔	✔	✔	
20	OPTN1	Reserved for option module at slot 1	Input available to option module at slot 1. Usable only in conjunction with communication modules.	✔	✔	✔	✔	✔	
21	OPTN2	Reserved for option module at slot 2	Input available to option module at slot 2. Usable only in conjunction with communication modules.	✔	✔	✔	✔	✔	
22	USER0	Reserved for modified software	Input can be used by modified software	✔	✔	✔	✔	✔	
23	USER1	Reserved for modified software	Input can be used by modified software	✔	✔	✔	✔	✔	
24	USER2	Reserved for modified software	Input can be used by modified software	✔	✔	✔	✔	✔	
25	USER3	Reserved for modified software	Input can be used by modified software	✔	✔	✔	✔	✔	

Table 5.21 Settings of the function selectors

1 2 3 4 5 6 A
DE EN

BUS	KP/DM	Function	Effect	FIS00	FIS01	FIS02	FIS03	FIE0x	FIFx
26	MAN	Manual mode activation in field bus operation	An inverter module configured for bus operation can be switched to manual mode (e.g. setup mode or emergency operation)			✔	✔	✔	
27	ENC	Encoder input	Connection of A or B signal of a HTL encoder (section 6.3.1 "_79EN-Encoder evaluation")			✔	✔		
28	FMSI	Reference coupling input	Slave input for reference input in Master/ Slave coupling. (section 5.5.7 "_66MS-Master/Slave operation")		✔				
34	INCLK	Clock input	Input for reference input via a clock frequency of 0-10 kHz (section 5.2.5 "_25CK-Clock input/clock output")		✔				

Table 5.21 Settings of the function selectors

Explanatory notes

- In closed-loop control mode "FOR" an encoder with HTL signal is connected at inputs ISD02 and ISD03. Input ISD02 is assigned track A and ISD03 track B.
- If input ISD01 is assigned the function FMSI (fast reference coupling), the digital output OSD01 cannot be used.
- For characteristic switchover via CUSEL, the control location for the switchover must be set in parameter 651-CDSSL to TERM (terminal operation).
- The "MAN" function permits a device configured for bus operation to be operated by the operator locally. This function can be used for system setup or emergency operation mode.
  By the "MAN" function the parameters are automatically assigned new parameter values, as set out in Table 5.13. This is also done while the power stage is active - that is, online.
  To do so, the drive is stopped and the control location is placed at the manual operation point (Term). A restart can only be executed from the "TERM" control location when the 0 Hz reference has been reached. An active auto-start is only suppressed on switchover to control location "TERM".

Action	Function	Parameter
Control location	Terminals	260-CLSEL = TERM
Input ISD00	Start clockwise	210-FIS00 = STR
Input ISD01	Start anti-clockwise	211-FIS01 = STL
Reference channel 1	Analog input 0	276-RSSL1 = FA0
Reference channel 2	Off	277-RSSL2 = FCON

Table 5.22 Online changes based on activation of the input with the MAN function

Note: While the "MAN" function is active, the settings must not be saved in the device, as the reference structure is changed in the background and the "MAN" function would be activated after the next power-on.

Explanatory notes

- The digital inputs only evaluate static signals (see section 2.4 "Specification of control connections").

Terminals

The start command for a direction of rotation can be set by way of the terminals of the inverter module. The start commands determine the direction.

If the reference value has a negative preceding sign the fact is indicated during starting by an inverted response - that is to say, in response to Start Clockwise the motor shaft rotates anti-clockwise.

STL	STR	Explanation
0	0	STOP, Motor is uncontrolled if stop ramp and DC braking are off. Otherwise the motor decelerates with the programmed stop ramp or the preset braking current down to 0 Hz and is then brought to a standstill with the preset holding current for a variable holding time.
1	0	START anti-clockwise, Acceleration with ACCRx or DECRx
0	1	START clockwise, Acceleration with ACCRx or DECRx
1	1	BRAKING with DECRx or TDCRx. As soon as the motor reaches 0 Hz it is brought to a standstill with the preset holding current if the DC holding function is activated. Otherwise the motor is uncontrolled at standstill. The braking process can be interrupted by applying only one start contact; the motor then accelerates again.
0 ↓ 1	1 ↓ 0	REVERSE direction, overlap time (STL and STR = 1) min. 2 ms

Table 5.23 Truth table for control via terminals

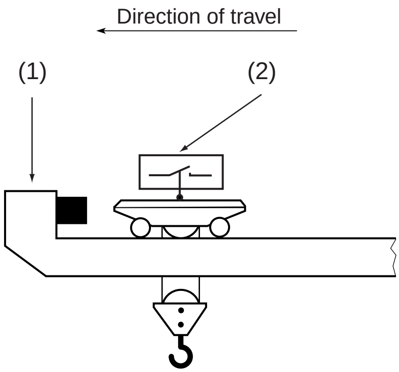
Limit switch evaluation

Limit switch evaluation is based on the evaluation of static signals. No signal edges are evaluated.

The limit switches are monitored dependent on direction of rotation, so reversed limit switches are signalled as errors. The drive runs down uncontrolled.

Mechanical passing of the limit switches is not permitted and is not monitored in terms of plausibility.

Example: If the right side limit switch is approached in clockwise running, this signal stops the drive. But if this signal is overridden and the limit switch is no longer damped, the drive starts up again in the direction of rotation if the clockwise start enable is still applied.



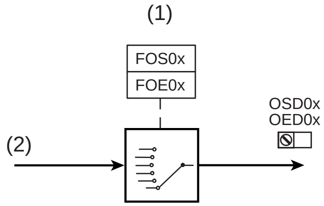
(1) Mechanical end stop
(2) Limit switches not overridable

Figure 5.19 Limit switch evaluation

Note: The evaluation of pulse switches or upstream limit switches is not supported. Bridges in limit switches, leads and switch cabinets are not monitored or detected.
In accordance with EN 954-1 "Safety of machines", category B is attained without additional control elements.

5.2.4 _240D-Digital outputs

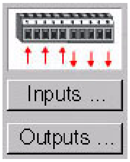
Function	Effect
• The function selectors determine the function of the digital outputs.	• Free function assignment of all digital outputs



(1) Selection of function of digital input
(2) Digital value

Figure 5.20 Function block for adaptation of the digital outputs

1.



2.

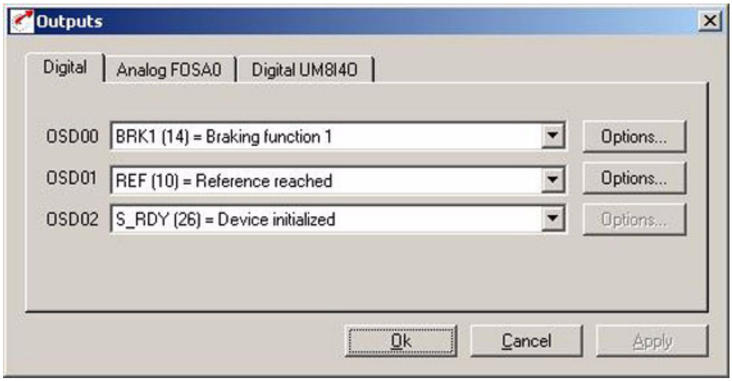


Figure 5.21 "Digital outputs" tab

3.

Options...

The Options screens are selected depending on the "Function" setting.

Parameters for digital outputs

Parameter	Function	Value range	FS	Unit	Online
230-REF_R	Reference-reached window	0 ... 20	0.099	Hz	✔
240-FOS00	Function selector digital standard output OSD00	see Table 5.25	BRK1		✔
241-FOS01	Function selector digital standard output OSD01	-“-	REF		✔ 1)
242-FOS02	Function selector digital standard output OSD02 (changeover relay)	-“-	S-RDY		✔
243-FOE00	Function selector digital output of user module OED00	-“-	OFF		✔
244-FOE01	Function selector digital output of user module OED01	-“-	OFF		✔
245-FOE02	Function selector digital output of user module OED02	-“-	OFF		✔
246-FOE03	Function selector digital output of user module OED03	-“-	OFF		✔
247-TENMO	Time between motor contactor and active loop control	0 ... 2000	50	ms	✔
1) Switch between FMSO/FCLK and simple output functions does not work online					

Table 5.24 Parameters from subject area "_24OD-Digital outputs"

Settings for 240-FOS00, ... 246-FOE03

BUS	KP/DM	Function	Effect	FOS00	FOS01	FOS02	FOE0x
0	OFF	No function	Output off.	✔	✔	✔	✔
1	ERR	Collective error message	Device in error state. The error must be eliminated and acknowledged before operation can be restarted. (section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔
2	WARN	Collective warning message	Parameterizable warning limit exceeded, device still ready. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
3	/ERR	Collective error message negated	Device in error state. The error must be eliminated and acknowledged for operation to be restarted. (section 5.3.10 "_51ER-Error messages")	✔	✔	✔	✔
4	/WARN	Collective warning message negated	Parameterizable warning limit exceeded, device still ready. Wire-break-proof output. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
5	ACTIVE	Control in function	Power stage active and closed-loop/open-loop control in function	✔	✔	✔	✔
6	ROT_R	Clockwise rotation	Motor running clockwise	✔	✔	✔	✔
7	ROT_L	Anti-clockwise rotation	Motor running anti-clockwise	✔	✔	✔	✔
8	ROT_0	Motor at standstill	Motor in standstill window (f_{ref}=0 Hz). Control mode FOR: dependent on actual value Control mode SFC: dependent on reference value Control mode VFC: dependent on reference value Refer to the information given under "Explanatory notes".	✔	✔	✔	✔
9	LIMIT	Reference limitation active	The internally processed reference value exceeds the reference limit and is restricted to the limit value. (section 5.3.1 "_30OL-Frequency limitation")	✔	✔	✔	✔
10	REF	Reference reached	The preset reference has been reached. Control mode FOR: dependent on actual value Control mode SFC: dependent on reference value Control mode VFC: dependent on reference value Refer to the information given under "Explanatory notes".	✔	✔	✔	✔
11	SIO	Access by control word of LustBus	Output can be set via the serial interface by the LUSTBUS control word. (section 5.4.1 "_55LB-LUSTBUS")	✔	✔	✔	✔

Table 5.25 Settings for function selector FOxxx of the digital outputs

BUS	KP/DM	Function	Effect	FOS00	FOS01	FOS02	FOE0x
12	OPTN1	Reserved for option module at slot 1	Output available to option module at slot 1. Usable only in conjunction with communication modules.	✔	✔	✔	✔
13	OPTN2	Reserved for option module, slot 2	Output available to option module at slot 1. Usable only in conjunction with communication modules.	✔	✔	✔	✔
14	BRK1	Holding brake function 1 (without motor current monitoring)	Output is activated if actual speed in control modes FOR/SFC has exceeded value in parameter FBCxx. In open-loop control mode VFC the reference infringement is evaluated. (section 5.5.1 "_31MB-Motor holding brake")	✔	✔	✔	✔
15	BRK2	Holding brake function 2	Output is activated if, in VFC (SFC), the control reference or, in FOR, the control actual value has exceeded the value in parameter SSCxx (clockwise: SSCW, anti-clockwise: SSCCW)	✔	✔	✔	✔
16	WUV	Warning: undervoltage in DC link	Warning message when DC-link voltage has fallen below value in parameter 503-WLUV. Device ready (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
17	WOV	Warning: overvoltage in DC link	Warning message when DC-link voltage has exceeded value in parameter 503-WLUV. Device still ready. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
18	WIIT	Warning, I^2t integrator started (device)	Warning message when integrator of current I^2 over time t has tripped to protect the device. (section 5.3.3 "Device protection")	✔	✔	✔	✔
19	WOTM	Warning: motor temperature	Warning message when motor temperature has exceeded value in parameter 502-WLTM. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
20	WOTI	Warning: heat sink temperature of device	Warning message when the heat sink temperature of the device has exceeded the value in parameter 500-WLTI. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
21	WOTD	Warning: interior temperature of device	Warning message when device interior temperature has exceeded value in parameter 501-WLTD. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
22	WIS	Warning message: apparent current limit value	Warning message when apparent current has exceeded value in parameter 506-WLIS. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
23	WFOUT	Warning message: output frequency limit	Warning message when output frequency has exceeded value in parameter 505-WLF. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔

Table 5.25 Settings for function selector FOxxx of the digital outputs

BUS	KP/DM	Function	Effect	FOS00	FOS01	FOS02	FOE0x
24	WFDIG	Warning: master reference value incorrect	Warning message when the reference value of the master passed to the slave is incorrect. (section 5.3.9 "_50WA-Warning messages")	✔	✔	✔	✔
25	WIT	Warning: ixt integrator started (motor)	Warning message when integrator for current I over time t has tripped to protect the motor. (section 5.3.2 "_33MO-Motor protection")	✔	✔	✔	✔
26	S_RDY	Device initialized	Output is activated if the device is initialized after power-on.	✔	✔	✔	✔
27	C_RDY	Device ready	Output is activated if by setting the signal ENPO the device is "ready to start", parameters for a UDS switchover have been completely reset and there are no error messages.	✔	✔	✔	✔
28	DCV	DC-link buffering active	DC link is buffered by means of power failure bridging. (section 5.3.4 "_34PF-Power failure bridging")	✔	✔	✔	✔
29	USER0	Reserved for modified software	Output can be used by modified software	✔	✔	✔	✔
30	USER1	Reserved for modified software	Output can be used by modified software	✔	✔	✔	✔
31	USER2	Reserved for modified software	Output can be used by modified software	✔	✔	✔	✔
32	USER3	Reserved for modified software	Output can be used by modified software	✔	✔	✔	✔
33	FMSO	Reference coupling output, Master/Slave operation	Output of master for reference input to slave in Master/Slave coupling (section 5.5.7 "_66MS-Master/Slave operation")		✔		
34	OCLK	Clock output for reference input	Output for reference input via a clock frequency of 0-1 kHz (section 5.2.5 "_25CK-Clock input/clock output")		✔		
35	WTQ	Warning message: torque	Warning message when torque has exceeded value in parameter 507-WLTQ (see section 5.3.9 "_50WA-Warning messages").	✔	✔	✔	✔
36	ENMO	Switch motor contactor	Output is activated on start of control and remains active extended by the time 247-TENMO when the start is cancelled and the drive is stopped	✔	✔	✔	✔
37	/ENMO	Switch motor contactor, negated function	Output is deactivated on start of control and remains inactive extended by the time 247-TENMO when the start is cancelled and the drive is stopped	✔	✔	✔	✔

Table 5.25 Settings for function selector FOxxx of the digital outputs

Explanatory notes

- The warning messages are not displayed in the DRIVEMANAGER. They can be evaluated in bit-coded form in parameter 120-WRN.
- Parameters can be set for warning limits in subject area _50WA-Warning messages (section 5.3.9).
- The "reference reached" (REF) and "motor standstill" (ROT_0) functions are dependent on the selected operation mode.

Operation mode	Digital output function active		Message deviates from true motor speed
	Reference reached (REF)	Motor standstill (ROT_0)	
VFC	Reference ± REF_R	Reference ± REF_R	Dependent on slip
SFC	Reference ± REF_R	Reference ± REF_R	Dependent on estimated speed
FOR	Actual ± REF_R	Actual ± REF_R	None

Table 5.26 Dependency of digital output functions on operation mode

- With parameter 230-REF_R a range can be defined in which the reference (control mode: VFC/SFC) or actual (control mode: FOR) may deviate from the reference value without the "Reference reached" (REF) message being deactivated. This enables reference value fluctuations resulting from reference input via analog inputs to be taken into account.

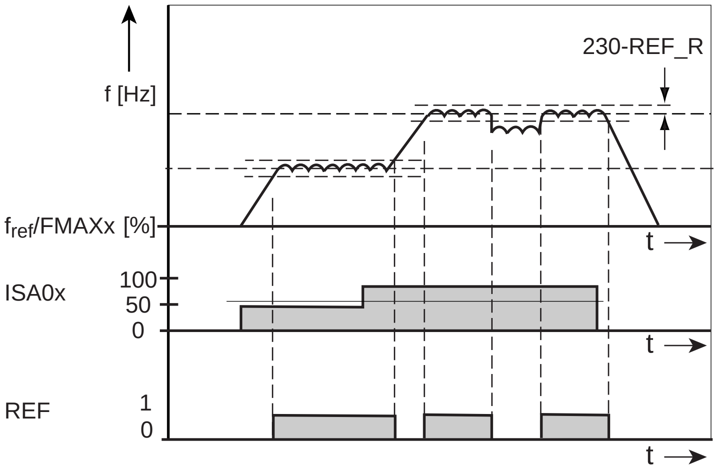


Figure 5.22 Digital output with "reference reached" setting when using the "reference-reached window"

Explanatory notes

- "Clockwise" (ROT_R) and "anti-clockwise" are detected dependent on parameter 230-REF_R.

Operation mode	Digital output function active	
	ROT_R	ROT_L
VFC	Positive reference + REF_R	Negative reference -REF_R
SFC	Positive reference + REF_R	Negative reference -REF_R
FOR	Positive actual + REF_R	Negative actual -REF_R

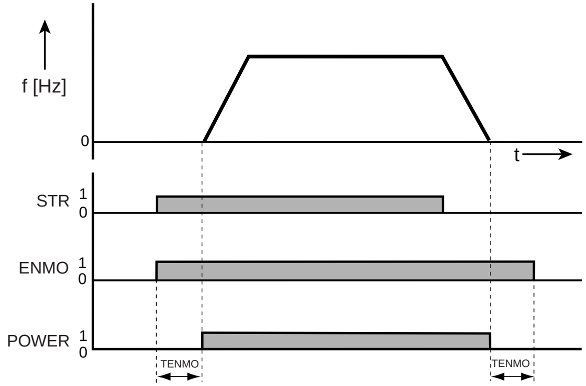
Table 5.27 Overview of direction recognition dependent on control mode

- The motor holding brake function **BRK2 cannot be activated or deactivated online**.

Explanatory notes

- The motor cable must always be switched with the power cut, otherwise problems such as burnt-out contactor contacts or inverter overvoltage or overcurrent shut-off will occur.
  To ensure the power is cut when switching, the contacts of the motor contactor must be closed before enabling the inverter power stage. In the reverse case, the contacts must remain closed until the inverter power stage is shut off.
  This is done by configuring appropriate safety times for switching of the motor contactor in the control sequence of your machine or using the special ENMO software function of the CDA3000 inverter.
- A power contactor in the motor cable can be controlled by the frequency inverter. The pick-up and drop-out times of the power contactor can be incorporated by way of timer parameter 247-TENMO. In this way you can ensure that after a start enable the reference is only specified when the contactor is closed, or if the power stage is inactive the motor is isolated from the frequency inverter by contactor.

Note: The TENMO timer time should allow additional times for typical contactor bounce. They may extend over several hundred ms, depending on contactor.



ENMO Motor power contactor
POWER Frequency inverter power stage

Figure 5.23 Motor contactor control via digital output with setting ENMO

- With the setting 247-TENMO=0 the motor contactor functionality is disabled.
- When the ENMO function is activated the motor contactor is automatically closed during auto-tuning.
- The motor contactor functionality is active when one of the function selectors of the digital outputs OSD0x or OED0x has the value ENMO or /ENMO.

Note: If a switch is made in the motor cable with the power stage still active, to avoid error message E-OC resulting from transient currents in the switching phase a motor choke should be installed.
Also, in the event of error message E-OC1 a check is made prior to output of the error message whether the hardware enable ENPO is applied. If it is not, an intentional switch in the motor cable by a motor contactor is assumed, and the error message is suppressed.

5.2.5 _25CK-Clock input/clock output

Function	Effect
• Definition of the internal processing of the clock input • Scaling of input frequency of clock input • Definition of output frequency of clock output dependent on modulation frequency of power stage	• The reference value can be set by way of a clock frequency • The actual value is mapped onto a clock signal at OSD01

1.

2.

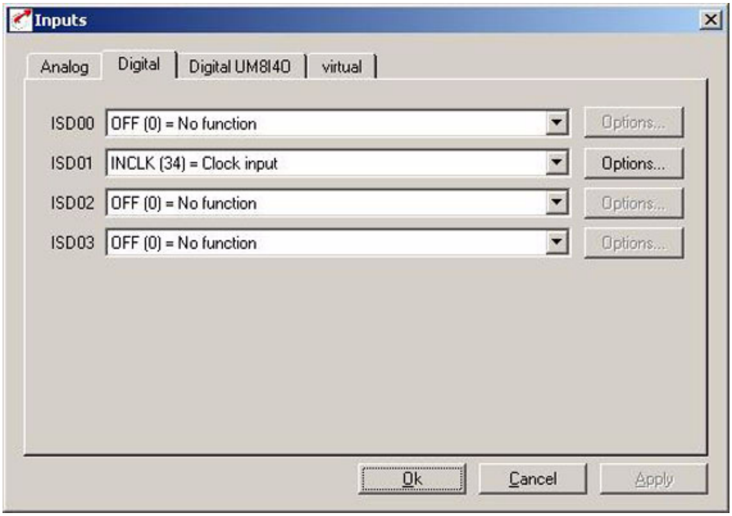


Figure 5.24 Clock input

3.

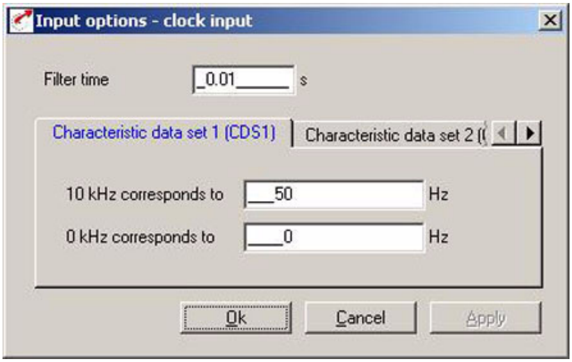


Figure 5.25 INCLK input

Parameters for clock input

Parameter	Function	Value range	FS	Unit	Online
251-FFMX1	CDS1: Maximum value clock input ISD01 at 10 kHz	-1600 ... 1600	50	Hz	
252-FFMN1	CDS1: Minimum value clock input ISD01 at 0 kHz	-1600 ... 1600	0	Hz	
253-FFMX2	CDS2: Maximum value clock input ISD01 at 10 kHz	-1600 ... 1600	50	Hz	
254-FFMN2	CDS2: Minimum value clock input ISD01 at 0 kHz	-1600 ... 1600	0	Hz	
255-INCLF	Filter time constant for the clock input	0.002-20	0.01	s	

Table 5.28 Clock input parameters of subject area "_25CK-Clock input/ clock output"

Explanatory notes on clock input

- Use of the clock input is restricted to the digital input ISD01. To activate the fast clock input, set function selector 211-FIS01 = INCLK.
- By way of the digital input ISD01 the reference of the device can be specified with a clock signal of 0-10 kHz.

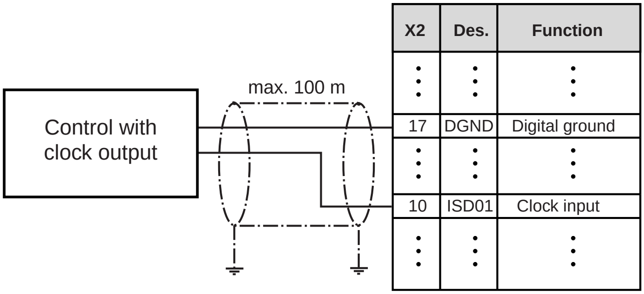


Figure 5.26 Wiring with reference input via clock input

Scaling of clock input

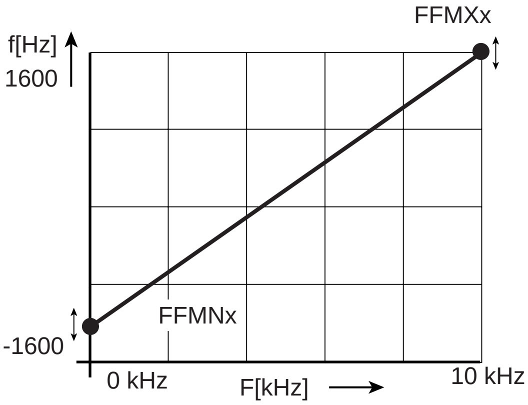
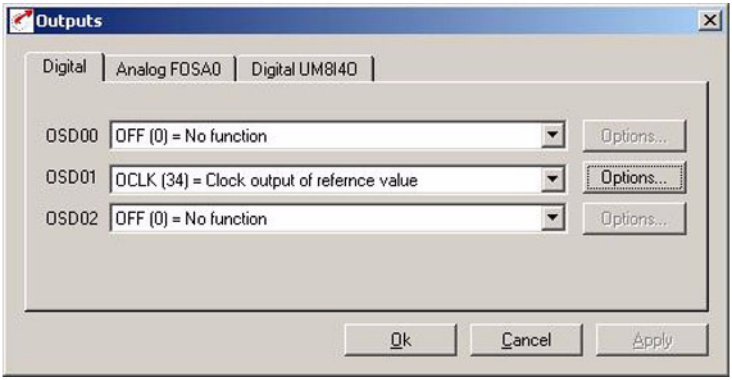


Figure 5.27 Scaling of clock input ISD01

2.



3.

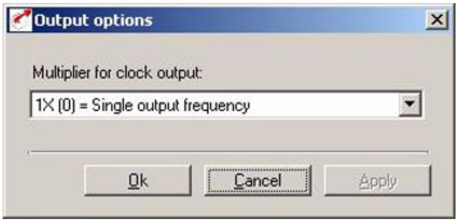


Figure 5.28 Clock output

Parameters for clock output

Parameter	Function	Value range	FS	Unit	Online
250-OCLK	Multiplier for clock output OSD01	1x, 2x, 4x ... 128x	1x		

Table 5.29 Clock output parameters of subject area "_25CK-Clock input/ clock output"

Explanatory notes on clock output

- Use of the clock output is restricted to the digital output OSD01.
- To activate the fast clock output, set function selector 241-OSD01=OCLK.
- The transmission ratio is adjustable in increments of 2^n from 1x to 128x, and is limited to a maximum of half the switching frequency of the power stage (parameter 690-PMFS).
- The clock signal of output OSD01 is 0-1 kHz with negligible jitter. At a higher output clock rate the inaccuracy of the clock signal increases because of the jitter. Consequently, specifications here only take into account a clock signal of 0...1 kHz.
- The clock signal is composed from the output frequency times the value of the multiplier 250-OCLK.

Connection example

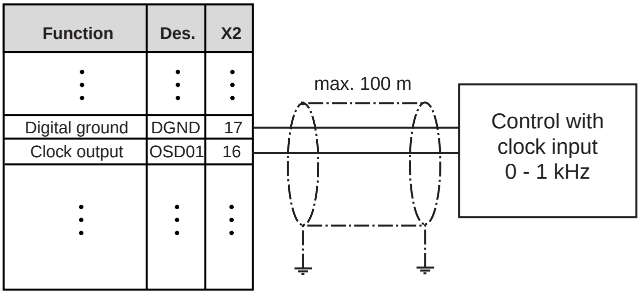


Figure 5.29 Wiring when using the clock output

Note: The clock cables must be shielded. The shield should be earthed across a wide area on one side if there is a risk of equalizing currents. The shielding effect against high-frequency interference signals (MHz range) is significantly reduced, however.

Condition of multiplier 250-OCLK

$$OCLK \leq \frac{OFMX}{FMAXx} \leq \frac{PMFS}{FMAXx \cdot 2} \quad \text{with } OCLK = 2^X \quad (x=0, 1, 2, ... 7)$$

OFMX	Recommended max. output frequency of clock output
FMAXx	Maximum rotation frequency, parameter 303-FMAX1 or 305 FMAX2
PMFS	Switching frequency or power stage, parameter 690-PMFS

The quality of the outputted clock signal depends on the switching frequency of the power stage. In this, if the maximum output frequency OFMX is exceeded the clock signal becomes more and more asymmetrical.

Recommended max. output frequency of clock output OFMX dependent on switching frequency of power stage

PFMS [kHz]	OFMX [Hz]
4	1000
8	2000
16	4000

Table 5.30 Recommended max. output frequency of clock output

This results in the following table for the multiplier 250-OCLK dependent on switching frequency of the power stage and the maximum output frequency.

Maximum recommended multiplication value for parameter 250-OCLK

Switching frequency of power stage in [kHz]	Maximum output frequency FMAXx in [Hz]							
	50	100	150	200	250	300	350	400
4	16x	8x	4x	4x	4x	2x	2x	2x
8	32x	16x	8x	8x	8x	4x	4x	4x
16	64x	32x	16x	16x	16x	8x	8x	8x

Table 5.31 Maximum recommended multiplier in parameter 250-OCLK

Table 5.31 results in the following output frequencies for the clock output.

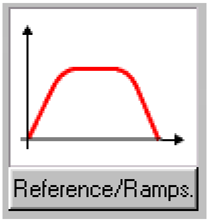
Output frequency of clock output OSD01 dependent on multiplier 250-OCLK

Switching frequency of power stage in [kHz]	Maximum output frequency FMAXx in [Hz]							
	50	100	150	200	250	300	350	400
4	800	800	600	800	1000	600	700	800
8	1600	1600	1200	1600	2000	1200	1400	1600
16	3200	3200	2400	3200	4000	2400	2800	3200

Table 5.32 Output frequency of clock output OSD01 dependent on multiplier 250-OCLK

5.2.6 _28RS-Reference structure

Function	Effect
• By way of the reference structure the two reference channels are added together. Each channel can draw a reference source from a predefined selection.	• The reference structure is adjusted to the application by the assistance parameters such that no adaptation is required for most applications. • For special requirements, the internal processing of the reference value can be adapted by way of the flexible reference structure.



2.

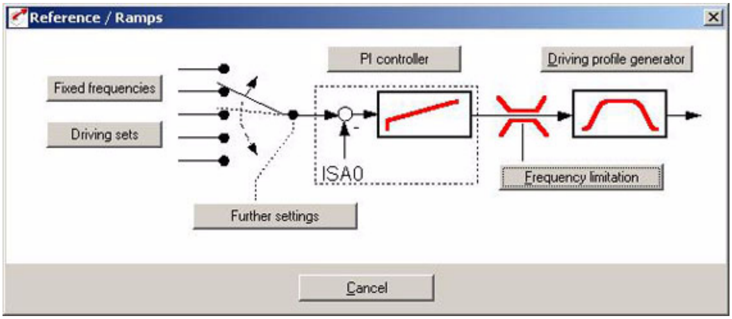
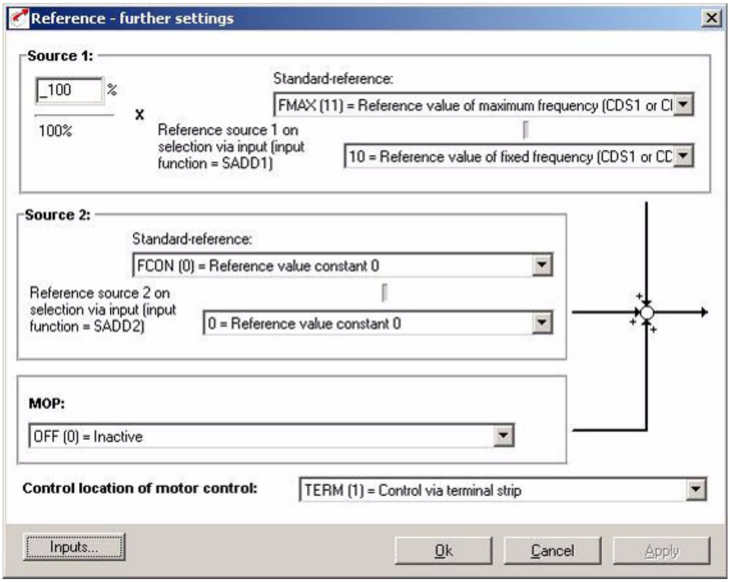


Figure 5.30 Reference/Ramps tab

3.



Note: This section is intended only for users who are unable to find their drive solution, or any suggested solution, in the preset application data sets.

Explanatory notes on Figure 5.31

1. **Reference channels:** Reference selectors (B) RSSL1 and RSSL2 switch a reference source (A) onto the reference channel. The selectors can additionally be switched by digital inputs. After reference channel 1 has been influenced by parameter RF1FA (0 ... 100%), reference channel 2 is added to it. The sum of the two channels can then be inverted. At various points within the reference structure the current reference value can be observed by means of parameters REF1 to REF6.
2. **Driving profile generator:** The driving profile generator consists of a ramp generator and a smoothing generator (F and G) The ramp generator can switch in operation between different ramp steepnesses from the two characteristic data sets (651-CDSSL). Simultaneously setting inputs STR and STL presets the reference 0 Hz for the ramp generator (see also section 5.2.7 "_26CL-Control location" and section 5.5.3 "_59DP-Driving profile generator").
3. **Driving sets:** The driving sets are activated by setting one of the reference selectors to FFTB, using the fixed frequencies FFTBx with the preset ramps of the ramp selector (see also section 5.5.5 "_60TB-Driving sets").
4. **Smoothing time:** The filter smoothes the beginning and end of the ramp to limit bucking. The acceleration and braking times are extended by the smoothing time.

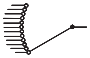
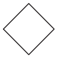
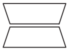
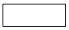
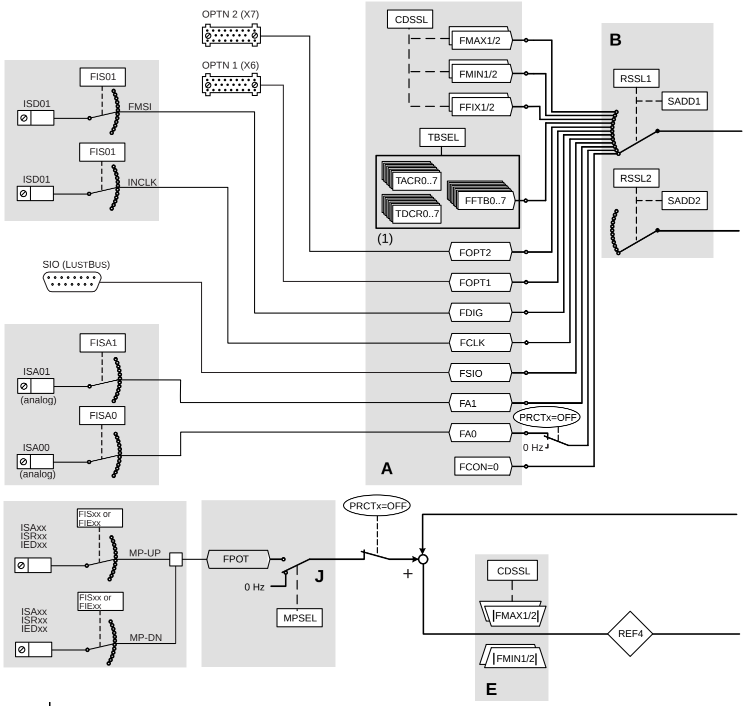
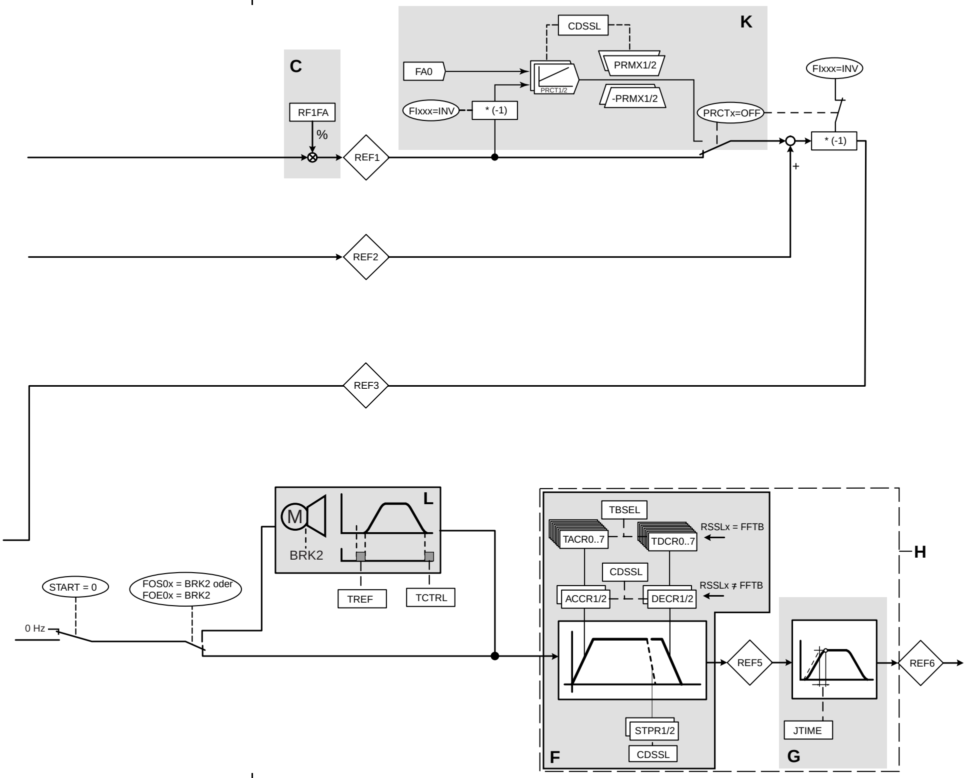
Symbol	Meaning
	Reference source (input), in some cases with second characteristic set
	Reference selector (switch)
	Parameter
	Interim reference values (for display only)
	Limitation of reference value
	Mathematical influence

Table 5.33 Symbols used in Figure 5.31

Reference input block diagram



A Reference sources
B Reference selectors (RSSLx) with offset function (SADDx)
C Reference adjustment, percentage
D Possibility of inversion
E Reference limitation (amount only)
F Ramp generator



G Activate/deactivate smoothing (inactive in table FFTB)
H Driving profile generator
J MOP function
K Process controller
L Motor holding brake in setting BRK2
(1) Table with 8 driving sets, incl. acceleration and braking ramps

Figure 5.31 Parameters from subject area _28RS Reference structure

Parameters of the reference structure

Parameter	Function	Value range	FS	Unit	Online
280-RSSL1	Reference selector 1	see Table 5.35	FMAX		✔
281-RSSL2	Reference selector 2	see Table 5.35	FCON		✔
282-FA0	Analog reference input ISA00	*	0	Hz	
283-FA1	Analog reference input ISA01	*	0	Hz	
284-FSIO	Reference serial interface	*	0	Hz	✔
285-FPOT	Reference of MOP	*	0	Hz	
286-FDIG	Digital reference input (reference coupling)	*	0	Hz	
287-FOPT1	Reference value of option slot 1	*	0	Hz	
288-FOPT2	Reference value of option slot 2	*	0	Hz	
289-SADD1	Offset value for reference selector 1	0 ... 11	10		✔
290-SADD2	Offset value for reference selector 2	0 ... 11	0		✔
291-REF1	Reference value of reference channel 1	*		Hz	
292-REF2	Reference value of reference channel 2	*		Hz	
293-REF3	Reference before reference limitation	*		Hz	
294-REF4	Reference before ramp generator	*		Hz	
295-REF5	Reference before ramp smoothing	*		Hz	
296-REF6	Reference for transfer to control	*		Hz	
297-RF1FA	Factor for reference channel 1	0 ... 100	100	%	

Table 5.34 Parameters from subject area _28RS Reference structure

Explanatory notes

- Parameter values which are produced from calculations and so are not editable have an asterisk (*) in the "Value range" column.
- The offset value for the reference selector is entered as a positive integer.

Setting for 280-RSSL1 and 281-RSSL2

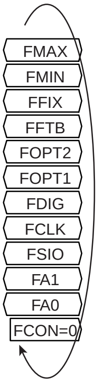
BUS	KP/DM	Function
0	FCON	Shuts off unused reference channel
1	FA0	Analog reference value of input ISA00 (± 10 V, 0 ... 20mA etc.)
2	FA1	Analog reference value of input ISA01 (0 ... + 10 V)
3	FSIO	Reference via serial interface
4	FCLK	Reference via clock signal 0 ... 10 kHz at ISD01
5	FDIG	Reference for Master/Slave operation
6	FOPT1	Reference of option module at slot 1 (user module)
7	FOPT2	Reference of option module at slot 2 (communication module)
8	FFTB	Table with eight fixed frequencies and associated acceleration and braking ramps; selection of table item via inputs with function FFTBx or directly in parameter TBSEL
9	FFIXx	Fixed frequency, switchable with characteristic data set switchover (FFIX1 and FFIX2)
10	FMINx	Minimum output frequency, switchable with characteristic data set switchover (FMIN1 and FMIN2)
11	FMAXx	Maximum output frequency, switchable with characteristic data set switchover (FMAX1 and FMAX2)

Table 5.35 Settings for reference selectors

Working with reference selectors RSSLx and offset SADDx

Reference channels 1 and 2 are supplied by the reference sources depending on the setting of reference selectors 276-RSSL1 and 277 - RSSL2. By adding together the two reference sources, an offset with reference channel 2 can be added to reference channel 1 for example.

An offset SADDx can be applied to the selectors RSSLx. In this way the reference selector can be switched between various sources in operation. The offset can be changed by way of the digital inputs. For this, the function selectors of the inputs must be configured accordingly to the parameter value SADDx. The offset consists of a positive integer (here: 0 ... 11), entered in the relevant parameter 28x-SADDx. The inputs set the offset for the reference selector with the rising edge and cancel the offset with the falling edge.



The reference sources are selected in loop sequence, i.e. after reference source FMAX comes reference source FCON. The offset is cancelled in the reverse direction.

↑ **Activate offset**

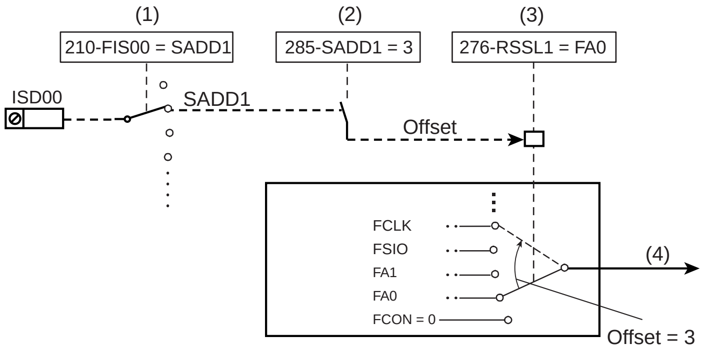
Figure 5.32 Selection of reference sources

Note: Selector RSSLx can only be switched by a digital input, assigned the offset SADDx. Several digital inputs with the offset SADDx do not cause repeated feedforward of selector RSSLx.

Example of reference source switching:

210-FIS00 = SADD1	The digital input ISD00 switches the offset value of parameter 285-SADD1 on/off
285-SADD1 = 3	The offset value of parameter SADD1 has a step-width of "3 increments"

If the digital input ISD00 is set, the reference selector RSSL1 is increased by the value "3 increments" from parameter 285-SADD1 (see Figure 5.33). If there is a falling edge at input ISD00, the offset is cancelled again, causing the original reference source to be set.



(1) Activate offset via digital input
(2) Offset value for base reference source
(3) Base reference source
(4) Reference from selected reference source on reference channel

Figure 5.33 Example: Input ISD00 delivers offset for reference selector RSSL1.
Operation of input ISD00 switches the reference source.

Procedure for setting reference input

The precondition is the factory setting (FS) in which only the first characteristic data set is active (650-CDSAC = 0). It is advisable always to follow the procedure below to set the reference input for your application:

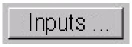
Step	Function	Explanation	Subject area	Parameter
1	Select reference source	Set the reference selector to the desired reference source (see table: "Explanation of reference sources").	"_28RS-Reference structure"	280-RSSL1
2	Define reference limit	Define the reference limits for minimum and maximum output frequency and for the absolute output frequency of the control.	"_30OL-Frequency limitation"	301-FMIN1 303-FMAX1 306-FMXA1
3	Set ramp generator	Enter the acceleration and braking ramps and any applicable stop ramp.	"_59DP-Driving profile generator"	590-ACCR1 592-DECR1 594-STPR1
4	Activate bucking limitation	Define the smoothing of your driving profile as necessary in order to obtain smooth transitions between the individual ramps.	"_59DP-Driving profile generator"	596-JTIME
5	Reference adjustment	Set the parameters for a reference adjustment as necessary. This may be a percentage factor by which reference channel 1 is multiplied, or an inversion of the common reference value from both reference channels by way of a function selector.	"_28RS-Reference structure"	297-RF1FA FIxxx=INV

Table 5.36 Procedure for setting the reference input for characteristic data set CDS1

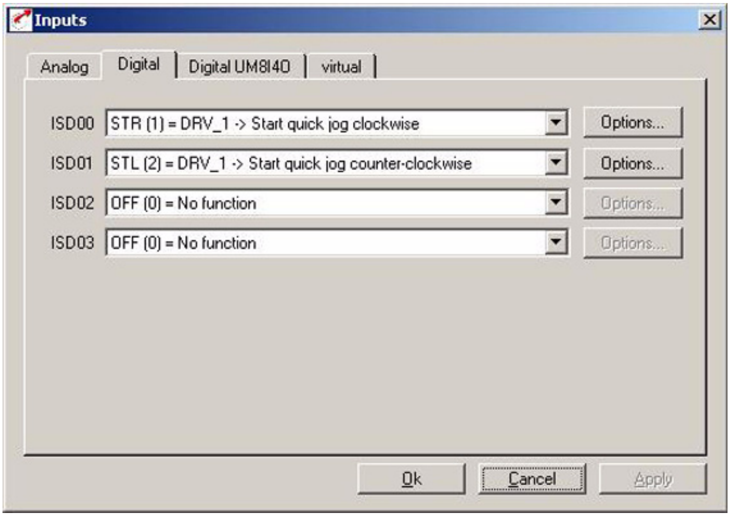
5.2.7 _26CL-Control location

Function	Effect
• The control location determines the source from which the control commands are given. • Auto-Start after power-up	• Possible control locations are: - Terminals - KeyPad KP200 - Serial interface - Option slot 1 or 2 • Drive auto-start

1.



2.



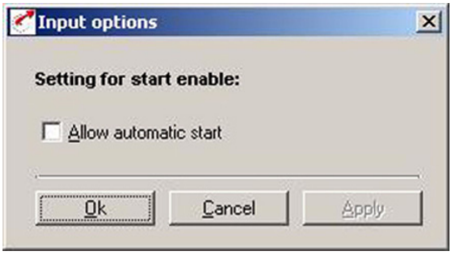
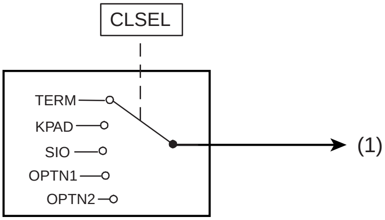


Figure 5.34 Setting of Auto-Start function



(1) Selected control location

Figure 5.35 Function block: Control location selector

Parameters for control location

Parameter	Function	Value range	FS	Unit	Online
7-AUTO	Auto-Start	OFF/ON	OFF		✔
260-CLSEL	Control location selector	see Table 5.38	TERM		✔

Table 5.37 Parameters from subject area _26CL Control location

Explanatory notes

- An auto-start is executed when a start command is received (STR/STL) and the hardware enable ENPO is set.

Attention! The drive starts up automatically after power-up or resetting of an error message dependent on the error response.

- Auto-Start is preset in the presets of the application data sets BUS_x.

Settings of the control location selector 260-CLSEL

BUS	KP/DM	Function
0	OFF	No function
1	TERM	Terminals
2	KPAD	KEYPAD KP200
3	SIO	Serial interface RS232 (Serial Input Output)
4	OPTN1	Option module at slot 1 (user modules)
5	OPTN2	Option module at slot 2 (communication modules)

Table 5.38 Settings for 260-CLSEL Control location selector

Terminals

The start command for a direction of rotation can be set by way of the terminals of the inverter module. The start commands determine the direction.

Attention! If the reference value (BUS, SIO, +/- 10 V, etc.) has a negative preceding sign, the fact is indicated on startup by an inverted response, i.e. the motor shaft rotates anti-clockwise in response to a clockwise start.

STL	STR	Explanation
0	0	STOP, Motor is uncontrolled if stop ramp and DC braking are off. Otherwise the motor decelerates with the programmed stop ramp or the preset braking current down to 0 Hz and is then brought to a standstill with the preset holding current for a variable holding time.
1	0	START anti-clockwise, Acceleration with ACCRx or DECRx
0	1	START clockwise, Acceleration with ACCRx or DECRx

Table 5.39 Truth table for control via terminals

STL	STR	Explanation
1	1	BRAKING with DECRx or TDCRx. As soon as the motor reaches 0 Hz it is brought to a standstill with the preset holding current if the DC holding function is activated. Otherwise the motor is uncontrolled at standstill. The braking process can be interrupted by applying only one start contact; the motor then accelerates again.
0 ↓ 1	1 ↓ 0	REVERSE direction, overlap time (STL and STR = 1) min. 2 ms

Table 5.39 Truth table for control via terminals

KEYPAD KP200

In the CONTROL menu the KEYPAD takes over complete control over the inverter. It attunes the control location selector and the reference channel 1 to KP200. The second reference channel is shut off.

By way of the KEYPAD control of the inverter can be seized and a reference value with preceding sign can be set to determine the direction of rotation.

Parameters for setting and adapting the KEYPAD are located in subject area _36KP-KEYPAD.
For more information on the KeyPad refer to the CDA3000 Operation Manual or see section 3.3 "Operation with KEYPAD KP200".

Serial interface

To control the inverter module via the serial interface (terminal X4) the LUSTBUS PROTOCOL is used. The DRIVEMANAGER user software uses this LUSTBUS protocol for communication and control of the frequency inverter.

The control location is set to SIO as soon as the DRIVEMANAGER FUNCTION "Control device" function is selected.

At the end of the control window the old setting is restored before the control function is taken over by the DRIVEMANAGER.

Note: If communication between the inverter module and the DRIVEMANAGER is interrupted, the setting can no longer be reset by the DRIVEMANAGER.

Parameters for setup and data exchange of the serial interface are located in subject area "_55LB-LustBus" (section 5.4.1).

Option slots 1 and 2

Activation of the inverter module by way of communication modules can be handled via the DRIVECOM state machine or the LUST-specific protocol.

The control location is set to OPTx.

The option slots are described in section 2.2 "Module mounting". Pay attention to the special notes set out there.
Parameters for setting and data exchange of the communication modules are described in section 5.4.2 "_57OP-Option modules".

Overview of option modules

Order designation	Option modules	Summary description	Control location
CM-CAN1	CAN_{Lust}	Conforming to CiA Draft Standard 301	OPTx
CM-CAN2	CAN_{open}	Conforming to CiA Draft Standard 402	OPTx
CM-DPV1	PROFIBUS-DP	Conforming to EN 50170 / DIN 19245	OPTx
UM-8I40	I/O module	Terminal expansion module with 8 inputs and 4 outputs	TERM

Table 5.40 Overview of option modules

5.3 Protection and information

Protection of the motor and of the CDA3000 inverter module is preset depending on the power class of the module. By means of parameter setting the protection can be adapted for special applications and the protection zone made more sensitive. These safety devices are indicated by warning and error messages. As an aid to setup, conclusions can be drawn from the current actuals and the display of device capacity utilization in the form of a peak value memory.

A special case is power failure bridging, which can be parameterized in response to infringement of a minimum voltage at the mains voltage input.

5.3.1 _30OL-Frequency limitation

Function	Effect
• Limitation of the output frequency for a characteristic data set	• Setting of maximum and minimum limit frequencies

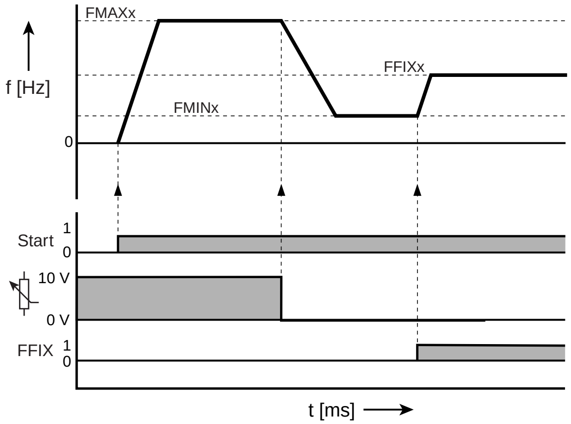
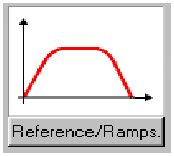
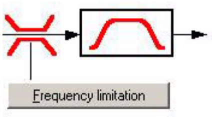


Figure 5.36 Limitation of output frequency



2.



3.

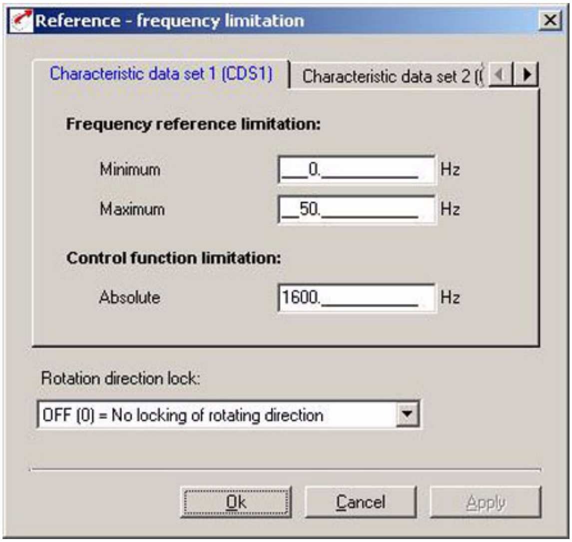


Figure 5.37 "Reference - frequency limitation CDS1" tab

Parameters of frequency limitation

Parameter	Function	Value range	FS	Unit	Online
301-FMIN1	CDS1: Minimum reference frequency	see Table 5.43	0	Hz	
302-FMIN2	CDS2: Minimum reference frequency	see Table 5.43	0	Hz	
303-FMAX1	CDS1: Maximum reference frequency	see Table 5.43	50	Hz	
305-FMAX2	CDS2: Maximum reference frequency	see Table 5.43	50	Hz	
306-FMXA1	CDS1: Absolute output frequency of control	see Table 5.43	BG1...5: 440 Hz BG6...8: 240 Hz	Hz	
307-FMXA2	CDS2: Absolute output frequency of control	see Table 5.43		Hz	
308-DLOCK	Activate directional lock	see Table 5.43	OFF	-	

Table 5.41 Parameters from subject area _30OL Frequency limitation

Settings for 308-DLOCK

BUS	KP/DM	Function
0	OFF	No directional lock
1	STR	Directional lock clockwise
2	STL	Directional lock anti-clockwise

Table 5.42 Settings for 308-DLOCK Activate directional lock

Explanatory notes

- With FMINx ≠ 0 Hz, after starting the output frequency is accelerated from 0 Hz with the ramp ACCRx to FMINx.
- The absolute maximum frequency FMXAx limits the output frequency of control functions, such as slip compensation in VFC mode.
- Changing parameter FMINx or FMAXx activates a controller initialization.
- The maximum reference frequency FMAXx and the absolute output frequency of the control FMXAx must always be greater than 0 Hz.
- The output frequencies of the different power classes are limited internally to maximum values based on the power stages and the modulation of the PWM signal.
- For the absolute output frequency, values up to 1600 Hz can be entered, though subject to the internal limitation (see Table 5.43).

Output frequencies of the power classes

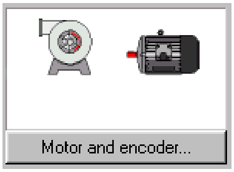
Power class	Size	Value range	
		FMINx/FMAXx	FMXAx
0.75 kW ... 15 kW	1 ... 5	0 ... 400 Hz	0 ... 440 Hz
22 kW ... 90 kW	6 ... 8	0 ... 200 Hz	0 ... 240 Hz

Table 5.43 Output frequencies of the frequency inverter power classes

5.3.2 _33MO-Motor protection

Function	Effect
• Monitoring of motor temperature by temperature sensors or by temperature-sensitive switches and Ixt monitoring.	The inverter module shuts off the motor with an error message: • E-OTM, if the motor temperature exceeds a programmable limit value. • E-OLM if the up-integrated current/time value exceeds the required motor-dependent limit value for a specific release time. This function replaces a motor circuit-breaker. • The inverter module can deliver a warning message when the Ixt motor protection integrator starts.

1.



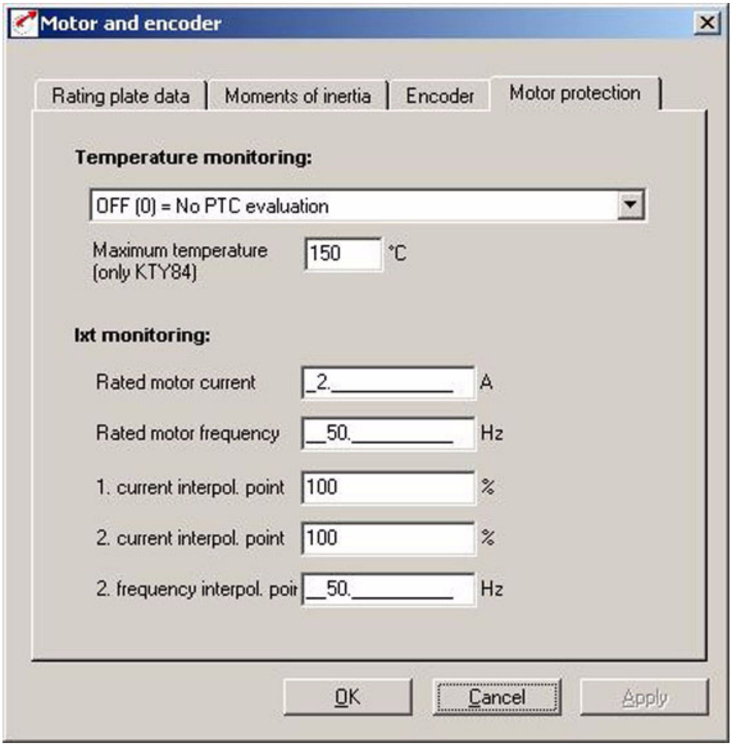
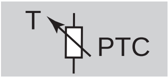


Figure 5.38 "Motor protection" tab



Parameters for PTC evaluation

Parameter	Function	Value range	FS	Unit	Online
330-MOPTC	Type of PTC evaluation	see Table 5.47	OFF		✔
334-MOTMX	Maximum motor temperature	10 ... 250	150	°C	✔

Table 5.44 Parameters for PTC evaluation from subject area _33MO Motor protection

Settings for 330-MOPTC

BUS	KP/DM	Function
0	OFF	Monitoring off
1	KTY	Linear PTC (KTY84-130, yellow)
2	PTC	Threshold PTC (to DIN 44081/44082)
3	TSS	Klixon (temperature switch as break contact)

Table 5.45 Settings for type of motor PTC evaluation

Explanatory notes

- The inverter module shuts off the motor with the error message E-OTM if the temperature exceeds a limit value.
  In evaluation by KTY84-130 the limit value can be set by parameter 334-MOTMX "Maximum motor temperature".
- The following temperature sensors can be evaluated:
  - Linear PTC (KTY 84-130, tolerance band yellow)
  - Threshold PTC (to DIN 44081, DIN 44082)
  - Thermostatic circuit-breaker (Klixon)
- With "KTY 84 -130" evaluation the current motor temperature is displayed in actual value parameter 407-MTEMP in °C.

Typical resistance values of a linear PTC (KTY 84 - 130)

Temperature (°C)	Typical resistance values (Ω) Tolerance ~ +/- 6%
-20	424
0	498
20	581
50	722
80	852
100	1000
150	1334

Table 5.46 Typical resistance values of a linear PTC of type KTY 84-130

Diagram of PTC KTY 84-130

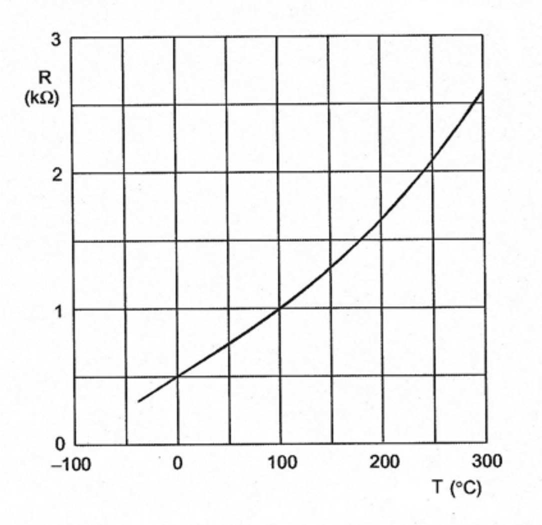


Figure 5.39 Resistance diagram as function of temperature of a PTC KTY 84-130

Typical resistance range of a DIN PTC

Temperature (°C)	Typical resistance values (Ω)
-20 ... 150	50 ... 4000

Table 5.47 Typical resistance values of a DIN-PTC with a TNF of 90 ... 160 °C

Diagram of a DIN PTC

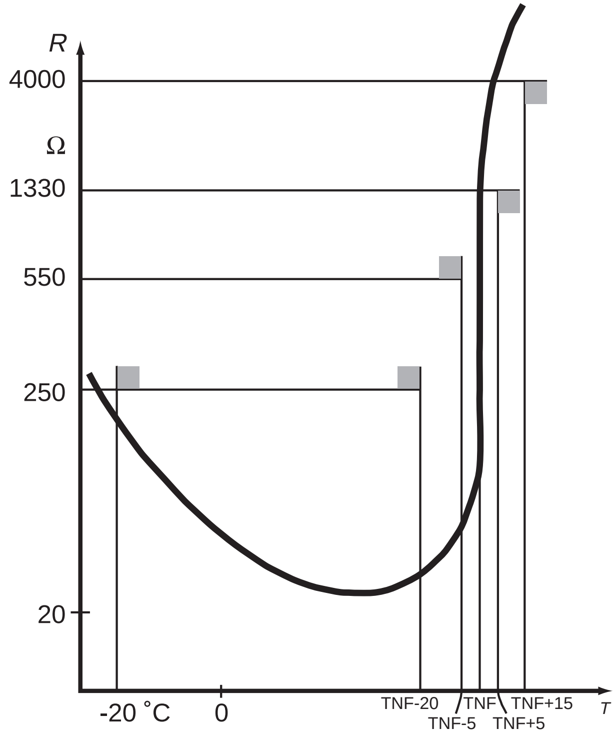


Figure 5.40 Resistance diagram as function of temperature of a DIN PTC

Note: The resistance of the DIN PTC is always defined relative to its nominal response temperature (TNF, formerly termed T_{NAT}).
The measurable resistance is dependent on the fitting variant (PTC in-line configuration).

PTC evaluation dependent on the temperature curve of an IEC standard motor

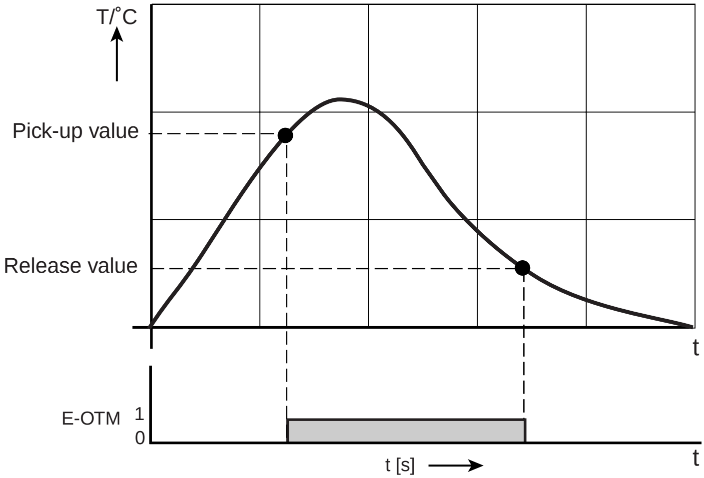
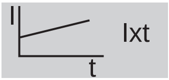


Figure 5.41 PTC evaluation operation diagram



Ixt monitoring

Ixt monitoring protects the motor against overheating over its entire speed range. This is especially important for internally cooled motors, since in lengthy service at low speed the cooling provided by the fan and the housing is insufficient. When set correctly, this function replaces a motor circuit-breaker. The characteristic can be adapted to the operating conditions by way of interpolation points.

Parameters for Ixt monitoring

Parameter	Function	Value range	FS	Unit	Online
331-MOPCB	2. current interpolation point (I_b) of the motor protection characteristic (referred to the max. characteristic current)	0 ... 100	100	%	
332-MOPCA	1. current interpolation point (I_a) of the motor protection characteristic (referred to the max. characteristic current)	0 ... 100	100	%	
333-MOPFB	2. frequency interpolation point (f_b) of the motor protection characteristic	0,1 ... 1600	50	Hz	
335-MOPCN	Rated motor current (I_N) for motor protection	dependent on inverter module, see Table 5.55	I_N	A	
336-MOPFN	Rated motor frequency (f_N) for motor protection	0.1 ... 1000	50	Hz	

Table 5.48 Parameters for Ixt monitoring from subject area _33MO Motor protection

Settings for 335-MOPCN

Inverter module	Recommended 4-pole IEC standard motor [kW]	Rated motor current for motor protection, MOPCN [A]
CDA32003	0.375	2.0
CDA32004	0.75	3.4
CDA32006	1.1	5.1
CDA32008	1.5	6.5
CDA34003	0.75	2.0
CDA34005	1.5	3.8
CDA34006	2.2	5.6
CDA34008	3.0	7.5
CDA34010	4.0	9.1
CDA34014	5.5	11.6
CDA34017	7.5	16.3
CDA34024	11	23.1
CDA34032	15	31.1
CDA34045	22	44.1
CDA34060	30	57.1
CDA34072	37	70.1

Table 5.49 Rated motor current in factory setting in inverter module

Inverter module	Recommended 4-pole IEC standard motor [kW]	Rated motor current for motor protection, MOPCN [A]
CDA34090	45	85.1
CDA34110	55	98.1
CDA34143	75	140.1
CDA34170	90	168.1

Table 5.49 Rated motor current in factory setting in inverter module

Note: During auto-tuning parameters 335-MOPCN Rated motor current and 336-MOPFN Rated motor frequency are adjusted to the values of the initial commissioning specifications.

Explanatory notes

- Ixt monitoring protects the motor against overheating over its entire speed range when the motor protection characteristic is adjusted. This is important for internally cooled motors, because in lengthy service at low speeds the cooling by the housing and the fan may not be adequate.

- To protect the motor, as a rule of thumb the motor protection characteristic and operation of the IEC standard motor should conform to the following limit values.

Frequency (Hz)	Rated motor current (%)
0	30
25	80
50	100

  Observe the motor manufacturers' specifications.

- The inverter module shuts off the motor with error message E-OLM if the up-integrated current time value exceeds the motor-dependent limit value for a specific release time. This function replaces a motor circuit-breaker.
- Owing to the motor cooling, the down integration of the Ixt monitoring takes 10 times longer than the up integration.
- Startup of the Ixt integrator can be delivered with the setting of function selector FOSxx=WIT to a digital output (see section 5.2.4 "_24OD-Digital outputs").

- The Ixt integrators of the individual user data sets (UDS) remain active, even if a user data set switchover is effected. This means that, with an inactive UDS, an Ixt integrator once started is down integrated. This takes account of the standstill time of a multi-axis system.

Motor protection characteristic in factory setting

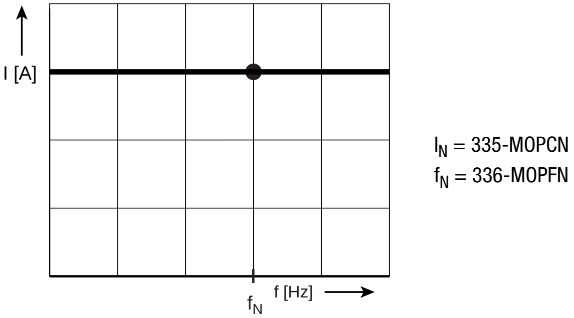


Figure 5.42 Factory setting of the motor protection characteristic

Setting of the motor protection characteristic

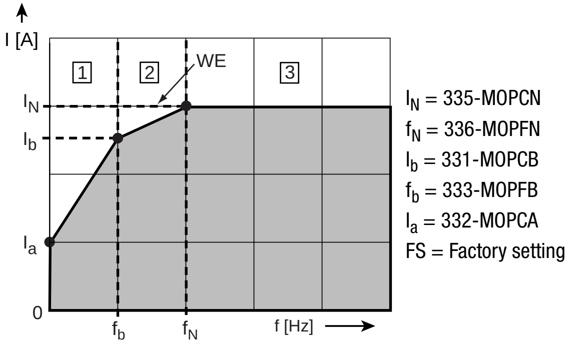


Figure 5.43 Characteristic adjustment by interpolation points below the rated frequency f_N

Explanatory notes on setting of the motor protection characteristic

- If the current to a frequency is below the characteristic line, the motor is at a safe operation point.

- If the current to a frequency is above the characteristic line, the motor is overloaded. The Ixt integrator is activated and depending on "Current x time" the drive is shut off with the error message E-OLM.
- The Ixt integrator starts at 110% of the current limit value of the motor protection characteristic.

$$I_{Start} = I_{Limit} \cdot 1.1$$

- If the current and frequency of an operation point are known, the Ixt monitoring can be calculated by the mathematical formula "straight line through two points".

The shut-off time of the Ixt monitoring can be calculated at an operation point (I_{act}/f_{act}):

$$I_{off} = \frac{2400\% \cdot s}{\frac{I_{act}}{I_N} \cdot 100\% - \frac{I_{lim}}{I_N} \cdot 110\%}$$

I_{act} = current at frequency f_{act}
I_{lim} = current limit value of motor protection characteristic at frequency f_{act}
I_N = rated motor current MOPCN

Calculation of the current limit value with adjusted motor protection characteristic by means of interpolation points:

Condition	Section Figure 5.43	Calculation
$\lvert f_{act} \rvert < MOPFB$	1	$I_{lim} = \frac{MOPCB - MOPCA}{MOPCB} \cdot If_{act} + MOPCA$
$MOPFB \leq \lvert f_{act} \rvert < MOFN$	2	$I_{lim} = \frac{MOPCN - MOPCA}{MOFN - MOPFB} \cdot (If_{act} - MOFN) + MOPCN$
$MOFN < \lvert f_{act} \rvert$	3	$I_{lim} = MOCNM$

Table 5.50 Overload calculation with adapted motor protection characteristic

Typical torque characteristic of a standard three-phase AC motor in standard inverter operation $P_{Inverter} = P_{Motor}$

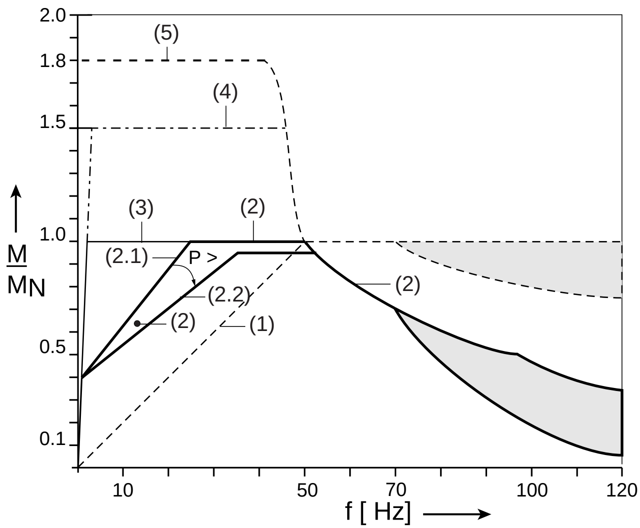


Figure 5.44 Typical torque characteristic of a standard three-phase AC motor

(1) Delivered power output of a standard three-phase AC motor in standard inverter operation

(2) Permissible torque characteristic of an internally cooled standard three-phase AC motor in standard inverter operation
(2.1) Typical characteristic at motor power outputs <4 kW
(2.2) Typical characteristic at motor power outputs >15 kW

(3) Permissible torque characteristic of an adequately externally cooled standard three-phase AC motor with standard inverter. It should, however, be noted that at motor power outputs >15 kW a rotor fan is very often used, meaning that the characteristic (3) may need to be reduced.

(4) Maximum permissible torque of a standard three-phase AC motor to VDE 0530 part 1 (120s).
Maximum torque with inverter modules which permit 150% overload.

(5) Maximum torque with inverter modules which permit 180% overload.

Note: Precise data can only be given by the manufacturers of the motors.

Motor protection possibilities

	A	B	C	D	C+D
Overload type	**Motor circuit-breaker (e.g. PKZM)1)**	**Thermistor protective relay**	**Motor PTC monitoring of the CDA3000**	**Software function: motor protection of the CDA3000**	**Motor PTC monitoring and motor protection of the CDA**
Overload in continuous operation 2)	●	●	●	●	●
Heavy starting 3)	●	◐	◐	●	●
Blocking 2)	●	●	●	●	●
Blocking 3)	●	◐	◐	●	●
Ambient temperature >50°C 2)	○	●	●	○	●
Impairment of cooling 2)	○	●	●	○	●
Inverter operation <50 Hz	○	●	●	◐	●

○ No protection ◐ Limited protection ● Full protection

1) Operation in the motor cable between frequency inverter and motor not permitted
2) The inverter and motor have the same power rating (1:1)
2) The inverter is at least four times larger than the motor (4:1)
4) Effective when motor warm, too long response time when motor cold
5) No full protection, because only the permissible current is applied as the basis

Table 5.51 Motor protection possibilities

In the factory setting, the shutdown time under differing loads can be read from the diagram below.

5.3.3 Device protection

Function	Effect
• Protection of the CDA3000 inverter module against destruction by overload	The inverter module shuts off the motor with an error message: • E-OTI, if the device temperature exceeds a fixed limit value. • E-OLI, if the up-integrated current time value exceeds the inverter module-dependent limit value for a specific release time. • E-OC in case of short-circuit or ground fault detection • The inverter module can deliver a warning message when the I^2xt device protection integrator starts.

The software and hardware of the CDA3000 inverter module autonomously monitors and protects the frequency inverter.

The power stage protects itself against overheating dependent on

- the heat sink temperature
- the current DC-link voltage
- the power stage transistor module used and
- the modulation switching frequency

Note: The current heat sink temperature of the inverter module in the range of the power transistors (KTEMP) and the device interior temperature (DTEMP) are displayed in °C (actual value/VAL menu).

Under high load the I^2xt integrator is activated. The I^2xt monitor protects the device against permanent overload. The shutdown limit is calculated from the rated current and the overload withstand capability of the inverter module.

Device	Shutdown limit, I^2xt device
CDA32.003 (0.375 kW) to CDA34.032 (15 kW)	1.8 x rated device current for 30 s
CDA34.045 (22 kW) to CDA34.170 (90 kW)	1.5 x rated device current for 60 s

Table 5.52 I^2xt shutdown limits according to device size

When the I^2xt integrator starts up a warning message can be delivered at a digital output.

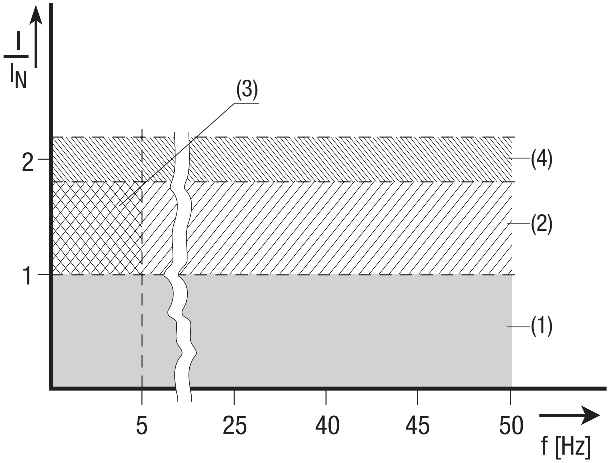
Function selector digital output = WIIT

Short

The hardware of the inverter module detects a short-circuit at the motor output and shuts down the motor.

Current capacity of inverter modules

The maximum permissible inverter output current and the peak current are dependent on the mains voltage, the motor cable length, the power stage switching frequency and the ambient temperature. If the conditions change, the maximum permissible current capacity of the inverter modules also changes. Refer to the following charts and tables for details of which current load is permissible under which changed service conditions.



(1) Continuous operation

(2) Intermittent* > 5 Hz rotating field frequency
Inverter modules 0.37 to 15 kW
I/I_N = 1.8 for 30 s at 4 kHz
I/I_N = 1.8 for 30 s at 8 kHz
I/I_N = 1.8 for 30 s at 16 kHz
Inverter modules 22 to 90 kW
I/I_N = 1.5 for 60 s at 4 kHz
I/I_N = 1.5 for 60 s at 8 kHz

(3) Intermittent* 0 to 5 Hz rotating field frequency
Inverter modules 0.37 to 15 kW
I/I_N = 1.8 for 30 s at 4 kHz
I/I_N = 1.25-1.8 for 30 s at 8 kHz
Inverter modules 22 to 90 kW
I/I_N = 1.5 for 60 s at 4 kHz
I/I_N = 1-1.5 for 60 s at 8 kHz

(4) Pulse mode
Inverter modules 0.37 to 15 kW
I/I_N = approx. 2.2 at 4, 8, 16 kHz
Inverter modules 22 to 90 kW
I/I_N = approx. 1.8 at 4, 8 kHz

*Intermittent $I_N > I_{eff}$ $\quad I_{eff} = \sqrt{\frac{1}{T} \cdot \sum_{i=1}^{n} I_i^2 \cdot t_i}$

Features

Inverter modules for 230 V systems

Inverter module	Rec. 4-pole standard motor [kW]	Switching frequency of power stage [kHz]	Rated current [A]	Peak current for intermittent mode 0 to 5 Hz [A]	Peak current for intermittent mode > 5 Hz [A]
CDA32.003,Cx.x	0.375	4 8 16	2.4 2.4 1.8	4.3 4.3 3.2	4.3 4.3 3.2
CDA32.004,Cx.x 1)	0.75	4 8 16	4 4 3	7.2 7.2 5.4	7.2 7.2 5.4
CDA32.006,Cx.x 1)	1.1	4 8 16	5.5 5.5 4.3	9.9 9.9 7.7	9.9 9.9 7.7
CDA32.008,Cx.x 1)	1.5	4 8 16	7.1 7.1 5.5	12.8 12.8 8	12.8 12.8 9.9
CDA34.003,Cx.x	0.75	4 8 16	2.2 2.2 1.0	2.2 2.2 1.0	4 4 1.1
CDA34.005,Cx.x 1)	1.5	4 8 16	4.1 4.1 2.4	4.1 3.6 -	7.4 7.4 4.3
CDA34.006,Cx.x 1)	2.2	4 8 16	5.7 5.7 2.6	5.7 5.7 -	5.7 5.7 4.7
CDA34.008,Wx.x	3.0	4 8 16	7.8 7.8 5	7.8 7.8 -	14 14 7.8
CDA34.010,Wx.x	4.0	4 8 16	10 10 6.2	10 8.8 -	18 16.5 7.8
CDA34.014,Wx.x	5,5	4 8 16	14 14 6,6	14 12,2 -	25 21 9,2

Peak current for 30 s with inverter modules 0.37 to 15 kW
Peak current for 60 s with inverter modules 22 to 90 kW
Cooling air temperature:
45 °C at power stage switching frequency 4 kHz
40 °C at power stage switching frequency 8, 16 kHz
1) With heat sink HS3... or additional cooling surface

Mains voltage 1 x 230 V -20 % +15 %
Motor cable length 10 m
Mounting height 1000m above MSL
End-to-end mounting

Table 5.53 Features

Inverter module	Rec. 4-pole standard motor [kW]	Switching frequency of power stage [kHz]	Rated current [A]	Peak current for intermittent mode 0 to 5 Hz [A]	Peak current for intermittent mode > 5 Hz [A]
CDA34.017,Wx.x	7.5	4 8 16	17 17 8	17 13.5 -	31 21.2 9.2
CDA34.024,Wx.x	11	4 8 16	24 24 15	24 24 -	43 40 22
CDA34.032,Wx.x	15	4 8 16	32 32 20	32 28 -	58 40 22
CDA34.045,Wx.x	22	4 8	45 45	45 39	68 54
CDA34.060,Wx.x	30	4 8	60 60	60 52	90 71
CDA34.072,Wx.x	37	4 8	72 72	72 62	112 78
CDA34.090,Wx.x	45	4 8	90 90	90 78	135 104
CDA34.110,Wx.x	55	4 8	110 110	110 96	165 110
CDA34.143,Wx.x	75	4 8	143 143	143 124	215 143
CDA34.170,Wx.x	90	4 8	170 170	170 147	255 212

Peak current for 30 s with inverter modules 0.37 to 15 kW
Peak current for 60 s with inverter modules 22 to 90 kW
Cooling air temperature:
45 °C at power stage switching frequency 4 kHz
40 °C at power stage switching frequency 8, 16 kHz
1) With heat sink HS3... or additional cooling surface

Mains voltage 1 x 230 V -20 % +15 %
Motor cable length 10 m
Mounting height 1000m above MSL
End-to-end mounting

Table 5.53 Features

5.3.4 _34PF-Power failure bridging

Function	Effect
• After a power failure the inverter module is powered by the rotational energy of the motor.	• A short-time interruption of the mains voltage merely results in a reduction in motor speed, which can be reset to the original level when the power is restored.

Note: The power failure bridging function should **only** be operated with control modes SFC and FOR. When the power failure bridging function is active the current-controlled startup function is deactivated.

1.

2.

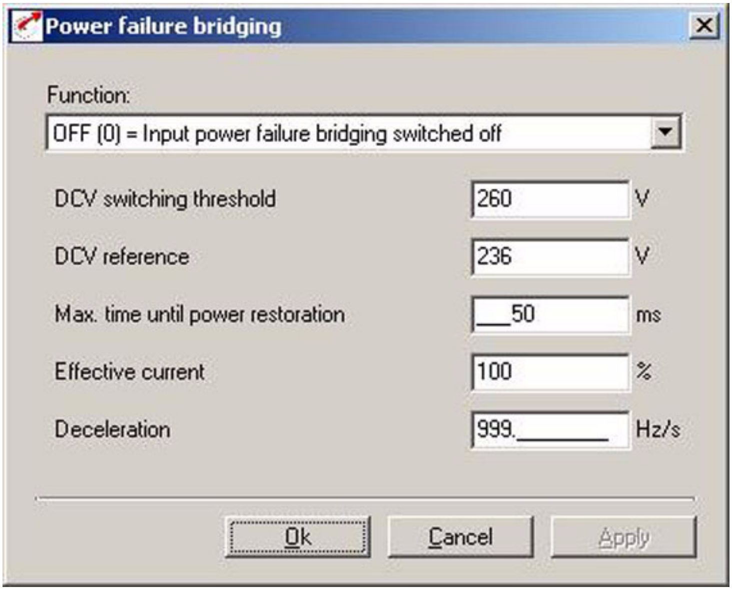


Figure 5.45 Power failure bridging

Parameters for power failure bridging

Parameter	Function	Value range	FS	Unit
340-PFSEL	Power failure bridging selector	see Table 5.55	0	
341-PFVON	DC-link switching threshold as from which power failure bridging is active	32.xxx ⇨212 ... 408 34.xxx ⇨425 ... 782	260 452	V V
342-PFVRF	DC-link control reference	32.xxx ⇨212 ... 408 34.xxx ⇨425 ... 782	236 438	V V
343-PFTIM	Time span until check as from mains power restoration	1 ... 10000	50	ms
351-PFC	Power failure bridging effective current reference	0 ... 180	100	%
354-PFR	Deceleration ramp power failure bridging	1 ... 999	999	Hz/s

Table 5.54 Parameters from subject area _34PF Power failure bridging

Power failure bridging selector 340-PFSEL

BUS	KP/DM	Function
0	OFF	Power failure bridging off
1	NOFCT	No function
2	RETRN	Longest possible DC-link bridging with restart
3	NORET	Longest possible DC-link bridging without restart
4	NOLIM	Fastest possible DC-link controlled speed reduction

Table 5.55 Settings of power failure bridging types

Note: The power failure bridging selector presets the parameters of the subject area to values for max. DC-link buffering or fastest possible speed reduction. We therefore recommend not changing the parameter setting.

Explanatory notes

- When "fastest possible DC-link controlled speed reduction" is set with 340-PFSEL=NOLIM and "longest possible DC-link buffering without restart is set with 340-PFSEL=RETRN, no check is made for restoration of mains power.
- If the DC-link control reference (342-PFVRF) is above the DC-link switching threshold above which power failure bridging is activated (341 -PFVON), the power failure bridging function jumps between "on" and "off". When "... with restart" is set, this results in a switch between deceleration and acceleration ramp.
- The power failure bridging deceleration ramp 354-PFR applies as the maximum limit value of DC-link control. The braking ramp is adapted dynamically by the DC-link control.
- The power failure bridging effective current reference 351-PFC can be used to influence the steepness of the dynamic braking ramp. In this way the effective current value influences the DC-link control.

Effect of setting of effective current reference 351-PFC

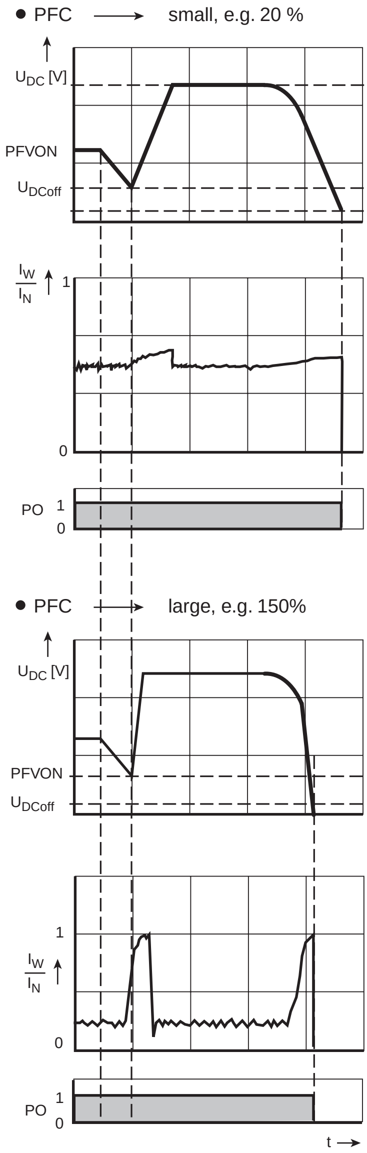
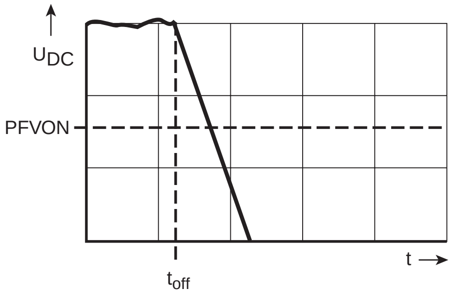


Figure 5.46   Effect of effective current reference PFC

Power failure detection

The power failure is detected based on the measured DC-link voltage (U_{DC}) when a parameterizable lower limit voltage threshold (PFVON) is infringed.



PFVON	DC-link switching threshold as from which power failure bridging is activated
t_{off}	Time of power failure

Figure 5.47 Power failure voltage threshold

Variants of power failure bridging

Variant	Restart	340-PFSEL	Diagram
Longest possible speed reduction	Yes	RETRN	1
	No	NORET	2
Fastest possible speed reduction	No	NOLIM	3

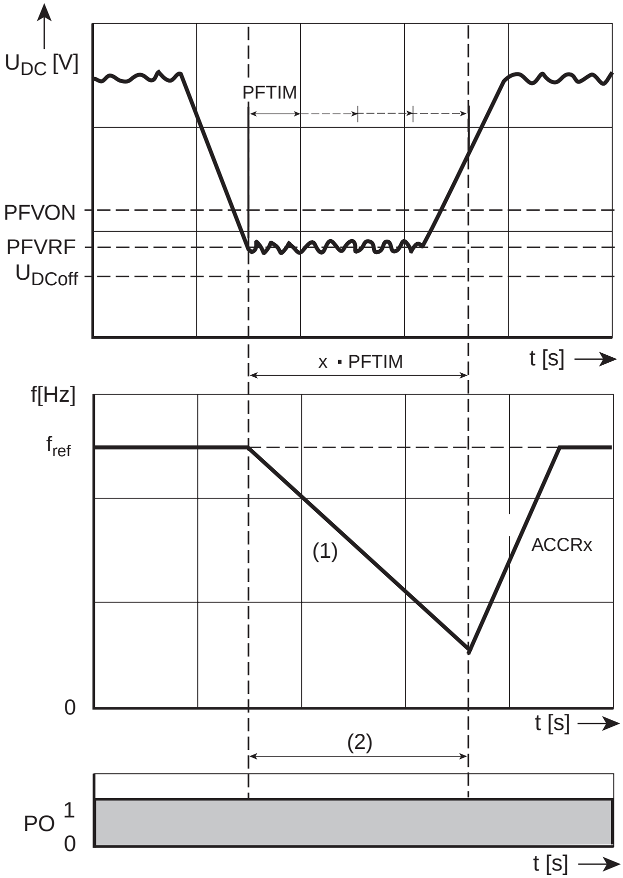
Table 5.56 Variants of power failure bridging

Explanatory notes on the power failure bridging variants

- After a power failure detection by limit value 341-PFVON of the DC-link voltage, the DC-link voltage is regulated to the reference value 342-PFVRF. This is done by means of a frequency jump, by which the asynchronous motor is set to a regenerative operating state.
- Regenerative braking is implemented by regulation to the reference value of the DC-link voltage 342-PFVRF.
- If the rotational energy of the motor is not sufficient to bridge the DC-link voltage, when the fixed undervoltage switching threshold U_{dcoff} is reached the power stage is disabled. The motor then runs down uncontrolled.

1

Figure 1: Longest possible speed reduction with restart

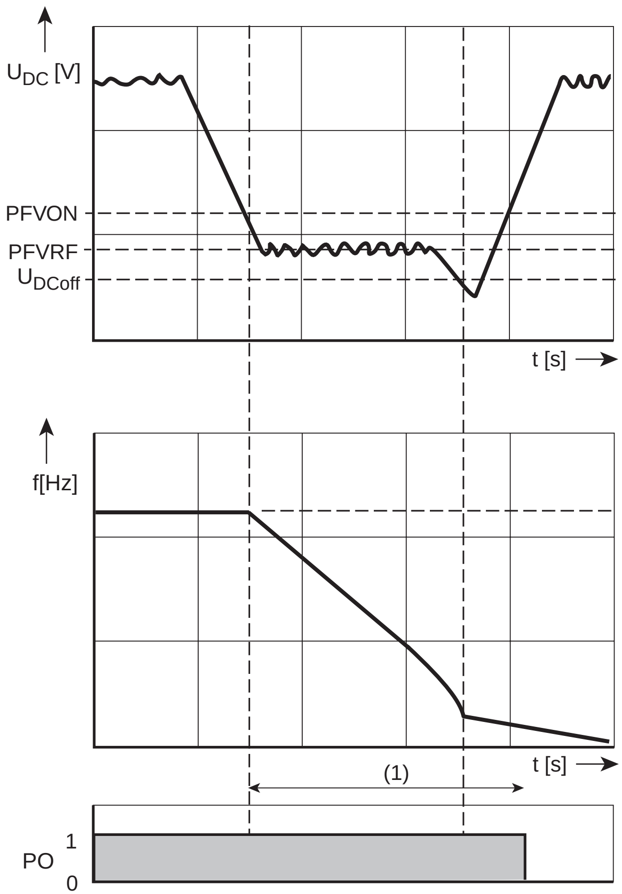


(1) Dynamic ramp
(2) Braking time

When power failure is detected the power failure bridging regulates the DC-link voltage U_{DC} to the voltage PTVRF. In the PFTIM cycle the DC-link voltage is checked for return of mains power. If the power is supplied before the DC-link voltage has collapsed to the voltage limit U_{dcoff}, the drive is accelerated to the currently preset frequency reference via the driving profile ramp ACCRx.

2

Figure 2: Longest possible speed reduction without restart

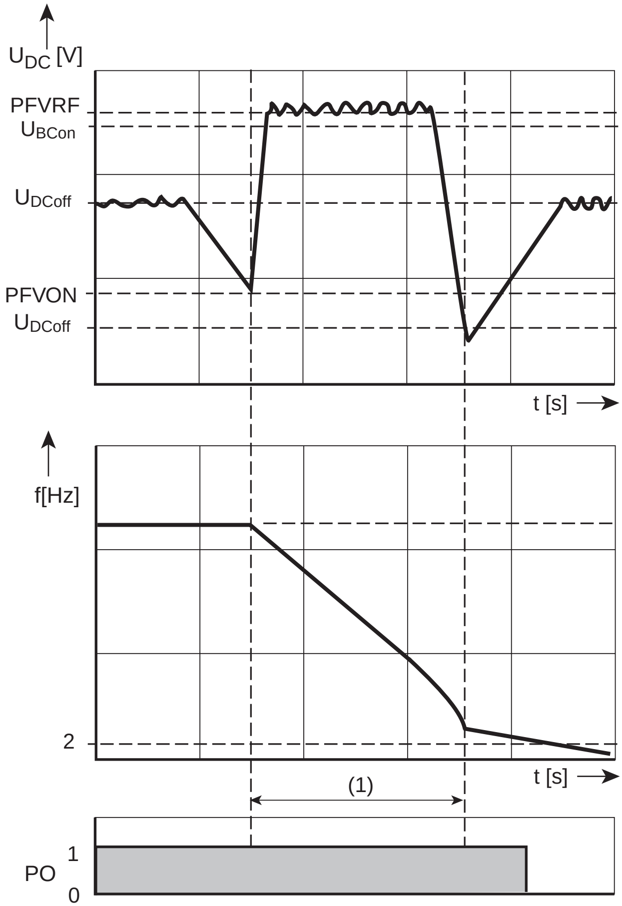


(1) Braking time

When power failure is detected the power failure bridging regulates the DC-link voltage U_{DC} to the voltage PTVRF. The drive is set to regenerative mode and the braking ramp is dynamically adjusted to attain the voltage reference PTVRF. If the energy gained from the regenerative operation is too low, the DC-link voltage falls to the voltage limit U_{DCoff} and the power stage is disabled. The drive then runs down uncontrolled.

3

Figure 3: Fastest possible speed reduction without restart (emergency stop in case of power failure)

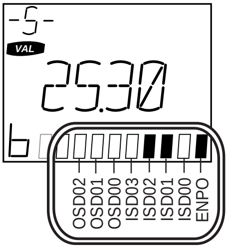


(1) Braking time

After power failure is detected the power failure bridging regulates the DC-link voltage U_{DC} to the reference voltage PTVRF, which is above the braking chopper response voltage U_{BCon}. With the braking chopper connected, the energy recovered from regeneration of the drive is discharged directly. During regeneration the braking ramp is dynamically adjusted by the control to provide maximum braking. If the DC-link voltage U_{DC} falls to the voltage limit U_{DCoff}, the power stage is disabled and the drive runs down uncontrolled. The power stage is also disabled if the frequency limit 2 Hz is reached.

5.3.5 _36KP-KEYPAD

Function	Effect
• Password settings for the user levels • Definition of the permanent displays	• Protection of the inverter module against unauthorized access • Selection of key actual values for permanent display



□ inactive (Low level)

■ active (High level)

Figure 5.48 Display for continuous actual value display and bar graph

The continuous actual value display and bar graph can be used separately to display actual values. The bar graph is used for status display of system values or to view trends of individual actual values.

1.

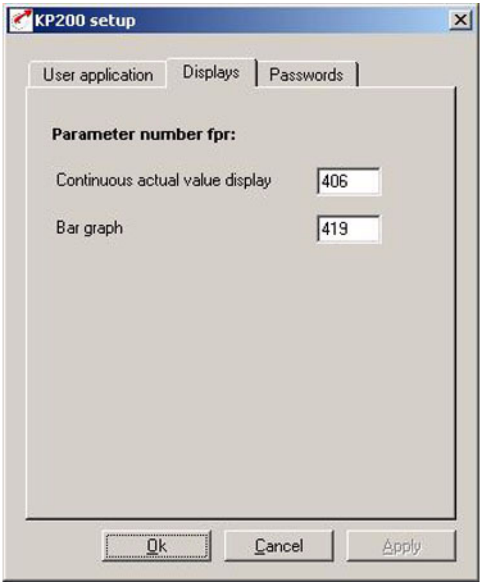


Figure 5.49 "Displays" tab

Parameters of the KEYPAD

Parameter	Function	Value range	FS	Unit	Online
360-DISP	Continuous actual value display of the KP200	see Table 5.58	406		✔
361-BARG	Bar graph display of the KP200		419		✔
362-PSW2	Password for user level 2 of the KP200	0 ... 65535	0		✔
363-PSW3	Password for user level 3 of the KP200	0 ... 65535	0		✔
364-PSW4	Password for user level 4 of the KP200	0 ... 65535	0		✔
367-PSWCT	Password for the CTRL menu of the KP200	0 ... 65535	0		✔
368-PNUM	Activate/deactivate parameter number display of the KP200	ON / OFF	OFF		✔
369-CTLFA	Multiplier of incremental value in CTRL menu of KP200	1 ... 65535	10000		✔
1-MODE	User level of KP200	1 ... 6	2		✔
13-UAPSP	Parameter list of user defined subject area _11UA in KP200	All parameters except actual value	see Table 5.60		

Table 5.57 Parameters from subject area _36KP KEYPAD

Explanatory notes

- The user levels are presented in detail in section 3.2. By way of parameter MODE the user level is selected and, where appropriate, a prompt is delivered for the password, unless deactivated by the entry 0.
- If a password is entered at the relevant user level, switch to a lower user level to activate the password via parameter 01-MODE.
- Parameter CTLFA is used to set the scrolling speed of the Up ↑ and Down ↓ cursor keys for setting reference values in the CTRL menu.

Error messages resulting from user error in operation of the KEYPAD or SMARTCARD are detailed in Appendix B.

Note: KEYPAD user error: Reset with **Start/Enter**
SMARTCARD: user error: Reset with **Stop/Return**.

Settings for 360-DISP and 361-BARG

Function	Parameter		KP200 user level	DISP	BARG
	DM	KP200			
Actual torque (SFC and FOR)	14	ACTT	2	✔	✔
Actual speed (FOR)	401	ACTN	2	✔	✔
Output voltage	404	VMOT	2	✔	
DC-link voltage	405	DCV	2	✔	✔
Current actual frequency	400	ACTF	2	✔	
Current reference frequency	406	REFF	2	✔	✔
Effective value of effective current	409	ACCUR	2	✔	✔
Effective value of apparent current	408	APCUR	2	✔	✔
Apparent power	428	PS	2	✔	
Effective power	429	PW	2	✔	
System time after power-up	86	TSYS	3	✔	
Inverter operating hours	87	TOP	3	✔	
Power stage operating hours	413	ACTOP	2	✔	

Table 5.58 Settings for continuous actual value display and bar graph

Function	Parameter		KP200 user level	DISP	BARG
	DM	KP200			
States of digital inputs and outputs	419	IOSTA	2	✔	✔
Filtered input voltage ISA00	416	ISA0	4	✔	
Filtered input voltage ISA01	417	ISA1	4	✔	
Filtered input current ISA00	418	IISA0	4	✔	
Motor temperature with KTY84 evaluation	407	MTEMP	2	✔	
Interior temperature	425	DTEMP	2	✔	✔
Heat sink temperature	427	KTEMP	2	✔	✔
Control word of system	422	CNTL	4	✔	
Faulty parameter in self-test	423	ERPAR	4	✔	
Filtered output voltage	420	OSA00	4	✔	
Process controller: Current control deviation	430	PRER	2	✔	

Table 5.58 Settings for continuous actual value display and bar graph

Scaling of parameters

Parameter	Function	Effect/Notes	Reference value
OFF	No function	Output off	
ACTF	Current actual frequency	Clockwise only (positive values only) Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Control mode VFC: display of reference frequency	FMAX1/2
ACTN	Current actual speed	Only only (positive values only) Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Control mode VFC: no display	FMAXx * 60 / number of pole pairs
APCUR	Current apparent current		$2{*}I_N$
ACCUR	Current effective current		$2{*}I_N$
ISA0	Voltage or current at analog input ISA00		10 V / 20 mA
ISA1	Voltage at analog input ISA01		10 V
MTEMP	Current motor temperature	Motor temperature only with linear evaluation (PTC)	200 °C
KTEMP	Current heat sink temperature	≤ 15 kW: Temperatures > 100 °C in the power stage module correspond to temperatures > 85 °C on the heat sink and result in a shut-off ≥ 15 kW: Temperatures > 85 °C result in a shut-off, because the temperature sensor is mounted directly on the heat sink.	200 °C
DTEMP	Current interior temperature	Interior temperatures > 85 °C result in a shut-off	200 °C
DCV	DC-link voltage	Referenced values dependent on device version CDA32.xxx 500 V CDA34.xxx 1000 V	500 V / 1000 V
VMOT	Motor voltage	Referenced values dependent on device version CDA32.xxx 500 V CDA34.xxx 1000 V	500 V / 1000 V
PS	Apparent power		$2{*}P_N$

Table 5.59 Scaling of actual parameter values

Parameter	Function	Effect/Notes	Reference value
PW	Effective power		$2*P_N$
ACTT	Current actual torque	Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Control mode VFC: no display	in section 5.2.2 "_200A-Analog output" Dependent on device, see Table 5.18
AACTF	Amount of current actual frequency	Clockwise (pos. value) and anti-clockwise (neg. value) are represented as amounts. Control mode FOR: true actual frequency Control mode SFC: estimated actual frequency Control mode VFC: display of reference frequency	FMAX1/2
AACTN	Amount of current actual speed	Clockwise (pos. value) and anti-clockwise (neg. value) are represented as amounts. Control mode FOR: true actual speed Control mode SFC: estimated actual speed Control mode VFC: no display	FMAXx * 60 / number of pole pairs

Table 5.59 Scaling of actual parameter values

User defined subject area _11UA

- The user definable subject area _11UA is only visible on the KEYPAD KP200 control unit.
- Parameter 13-UAPSP conceals a data box in which a maximum of 14 parameters for viewing in subject area _11UA can be entered.
- No actual value parameters can be displayed in the subject area.
- Parameter entries in the data box can only be made with the DRIVEMANAGER (from V3.0).

1.

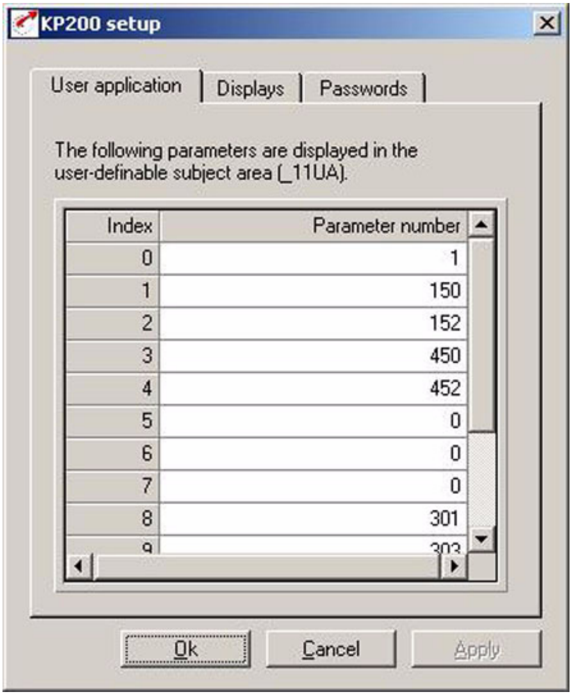


Figure 5.50 "User application" tab

Factory setting of parameter UAPSD

Index	Value	Parameter	
		Name	**Function**
0	01	01-MODE	Operation of the KP200
1	150	150-SAVE	Save setting in device
2	152	152-ASTER	Current application data set
3	180	180-FISA0	Function selector analog standard input ISA00
4	181	181-FISA1	Function selector analog standard input ISA01
5	242	242-FQS02	Function selector digital standard output OSD02 (relay)
6	270	270-FFIX1	CDS1: Fixed frequency
7	301	301-FMAN1	CDS1: Minimum frequency

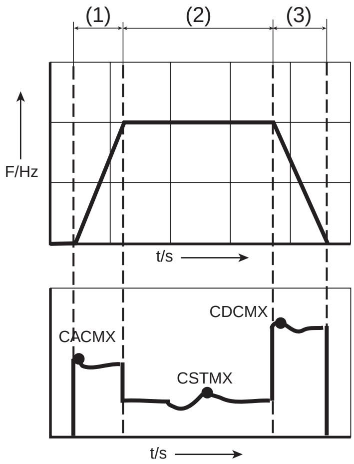
Table 5.60 Factory setting of user defined subject area _11UA in parameter 13-UAPSP

Index	Value	Parameter	
		Name	Function
8	303	303-FMAX1	CDS1: Maximum frequency
9	330	330-MOPTC	Rated motor current for motor protection
10	590	590-ACCR1	CDS1: Acceleration ramp
11	592	592-DECR1	CDS1: Deceleration ramp
12	594	594-STPR1	CDS1: Stop ramp
13	95	95-ERR1	Last error

Table 5.60 Factory setting of user defined subject area _11UA in parameter 13-UAPSP

5.3.6 _38TX-Device capacity utilization

Function	Effect
• Display of all information of importance for drive configuration as – Peak value memory – Mean device capacity utilization	• Optimization of drive configuration • Fast troubleshooting

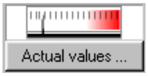


(1) Acceleration
(2) Stationary operation
(3) Braking

Figure 5.51 Peak current value storage for checking of drive dimensioning

The peak current value memory continuously stores the absolute peak values in the acceleration, stationary operation and braking phases. Also, the mean device capacity utilization is calculated by means of a filter time constant. When the values have been read they can be reset.

1.



2.

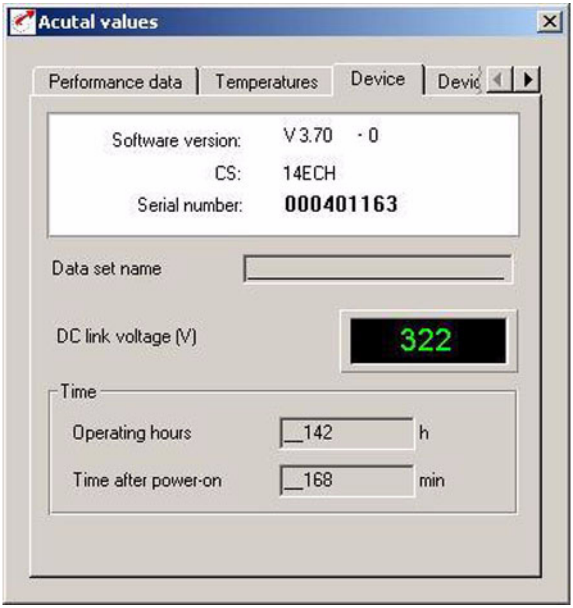


Figure 5.52 "Device capacity utilization" tab

Parameters for device capacity utilization

Parameter	Function	Value range	FS	Unit	Online
380-CACMX	Max. current in acceleration phase referred to device rated current	2 x I_N Device	*	%	
381-CDCMX	Max. current in braking phase referred to device rated current	0 ... 300% I_N Device	*	%	
382-CSTMX	Max. current in stationary operation referred to device rated current	0 ... 300% I_N Device	*	%	
383-CFCMX	Effective value of maximum current	0 ... 300% I_N Device	*	A	
384-CSCLR	Reset peak value storage	ACTIVE / CLEAR	ACTIVE		✔
388-CMID	Mean device capacity utilization ~ I_{eff}	0 ... 250% I_N Device	100	%	
389-CMIDF	Filter time constant for mean device capacity utilization	1 ... 1000	20	s	
435-CMIS	Mean device capacity utilization in stationary operation	0 ... 250% I_N Device	*	%	
436-CMISF	Filter time constant for device capacity utilization in stationary operation	0 ... 5000	1000	ms	

Table 5.61 Parameters from subject area _38TX Device capacity utilization

Explanatory notes

- Parameter values which are produced from current calculations and so are not editable have an asterisk (*) in the "Value range" column.
- Peak value storage in the entire subject area _38TX is reset by setting the value 384-CSCLR = CLEAR.
- For display of the mean device capacity utilization via 388-CMID, the filter time constant 389-CMIDF must be set to a value greater than five times the cycle duration of the drive.

Example: Mean device capacity utilization

The mean device capacity utilization is formed by way of a filter element in the form of a PT1 element. For this, the filter constant must be set to five times the cycle duration of the drive (CMIDF = 5 * T).

Block diagram:

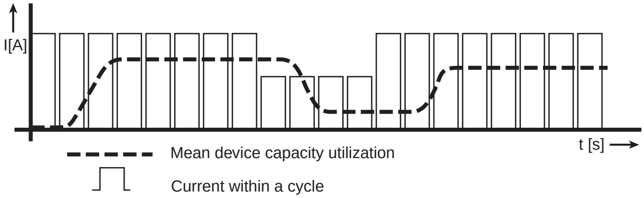


Figure 5.53 Mean device capacity utilization

Calculation of effective inverter capacity utilization

Note: The following condition must be met for safe operation:

$I_{eff} < I_{N-Inverter}$

The following condition must additionally be met:

$[(I_{Load})^2 - (I_{N-Inverter})^2] \cdot t_{Overload}$

with

0.37 kW to 15 kW:	$[1.8^2 - 1^2] \cdot 30\ s \leq 67.2\ A^2s$
22 kW to 90 kW:	$[1.5^2 - 1^2] \cdot 60\ s \leq 75\ A^2s$

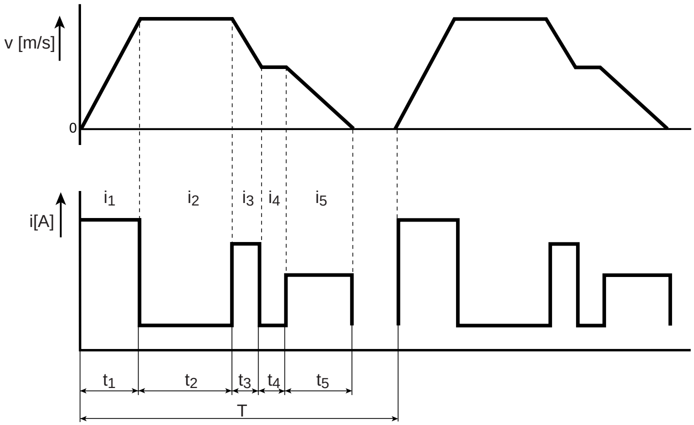


Figure 5.54 Effective inverter capacity utilization

$$= \sqrt{\frac{i_1^{\,2} \cdot \; t_1 + i_2^{\,2} \cdot \; t_2 + i_3^{\,2} \cdot \; t_3 + i_4^{\,2} \cdot \; t_4 + i_5^{\,2} \cdot}{T_{td}}}$$

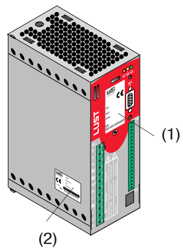
T_{td}	Clock cycle duration
i_x	Current in cycle segment x in [A]
t_x	Time for cycle segment x in [s]
I_{eff}	Effective inverter current

5.3.7 _39DD-Device data

Function	Effect
• Delivery of all data of the inverter module	• Unique identification of the inverter module and the device software

The device data contain information on the inverter hardware and software which should be kept to hand and quoted when calling on telephone support from LUST.

The device data can in part also be read from the rating plates.



1. Rating plate with performance data of hardware, type designation and serial number
2. Rating plate with software version details, type designation and serial number

Note: A more recent firmware than indicated on the software rating plate (2) should additionally be indicated by a notice on the device itself.

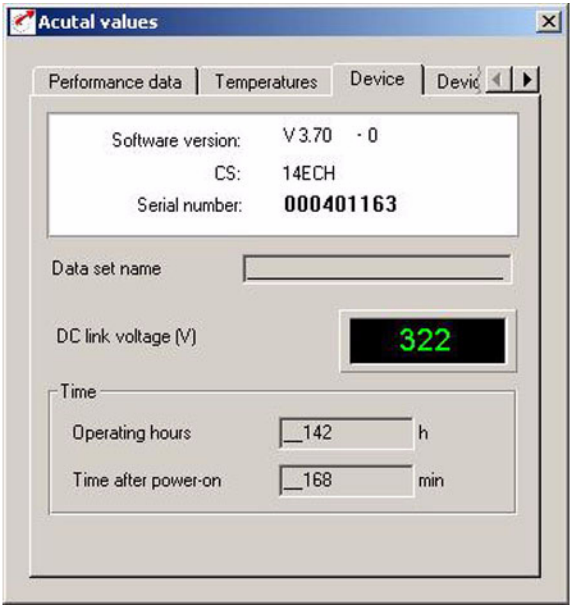


Figure 5.55 "Device" tab

Parameters for device data

Parameter	Function	Value range	FS	Unit	Online
89-NAMDS	Data set name	0-28 characters	-		✔
90-SREV	Base standard version of modified software	*			
92-REV	Software revision	*			
93-KOMP	Compatibility class of SMARTCARD	*			
106-CRIDX	Revision index as suffix to revision number	*			
127-S_NR	Serial number of device	*			
130-NAME	Symbolic device name	0-32 characters	-		✔
390-TYPE	Inverter type	*			
394-A_NR	Article number of device	*			
397-CFPNM	Device rated current	*		A	

Table 5.62 Parameters from subject area _39DD Device data

Explanatory notes

- Parameter values which are produced from current calculations and so are not editable have an asterisk (*) in the "Value range" column.
- The symbolic device name is used in device network lists for ease of identification of the inverter module. The parameter can only be edited with the DRIVEMANAGER. When a name is issued it is displayed ahead of the device designation.
- For ease of identification the complete data set (all four UDS) can be assigned a name, such as for archiving of machine data sets.

5.3.8 _VAL-Actuals

Function	Effect
• Display of all actuals of importance for diagnosis and monitoring	• Monitoring of process variables • Quick diagnosis of errors

Actuals

Actuals can be displayed in the DRIVEMANAGER (DM), KEYPAD KP200 (KP) or by way of the analog output OSA00:

Parameter	Function	DM	KP	OSA00	Unit
14-ACCT	Actual torque (in SFC or FOR)	✔	✔	✔	Nm
86-TSYS	System time after power-up in [min.]	✔	✔		Min.
87-TOP	Operating hours meter (total power on)	✔	✔		h
400-ACTF	Current output frequency	✔	✔	✔	Hz
401-ACTN	Current actual speed (with SFC and FOR)	✔	✔	✔	rpm
404-VMOT	Output voltage of inverter	✔	✔	✔	V
405-DCV	DC-link voltage	✔	✔	✔	V
406-REFF	Current reference frequency	✔	✔		
407-MTEMP	Motor temperature in KTY84 evaluation	✔	✔		°C
408-APCUR	Effective value of apparent current	✔	✔	✔	A
409-ACCUR	Effective value of effective current	✔	✔	✔	A
413-ACTOP	Operating hours of power stage	✔	✔		h
416-ISA0	Filtered input voltage ISA00	✔	✔	✔	V
417-ISA1	Filtered input voltage ISA01	✔	✔	✔	V
418-ISA0I	Filtered input current ISA00	✔	✔	✔	A
419-IOSTA	States of digital and analog I/Os	✔	✔		
422-CNTL	Control word of system (see field bus description)	✔			
423-ERPAR	Number of a faulty parameter in self-test	✔			
425-DTEMP	Interior temperature of the inverter module	✔	✔	✔	°C
427-KTEMP	Heat sink temperature of the inverter module	✔	✔	✔	°C
428-PS	Apparent power	✔	✔	✔	kVA
429-PW	Effective power	✔	✔	✔	kW

Table 5.63 Parameters from subject area _VAL Actual value parameters

Explanatory notes

- The actuals can be displayed in the KeyPad KP200 either in the bar graph or as numerical values in the continuous actual value display. For more details refer to section 5.3.5 "KEYPAD".
- The filtered input voltages and currents of parameters 416...418 are influenced by way of the parameters of subject area "_18IA-Analog inputs" (section 5.2.1).

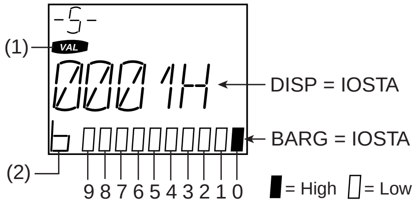
Control word of system (422-CNTL)

The control word of the system provides information on the current control status, such as Braking, Start Clockwise or Start Anti-clockwise. Details of the current status word of the inverter module should be kept to hand for quoting when calling on Telephone support from Lust.

The control word contains the control bits for activation of the inverter. In control via terminal the control bits are set according to the status of the inputs. The parameter is read-only and is used by Lust for support purposes.

Status word of system (419-IOSTA)

The status word can be displayed in hexadecimal form in the KEYPAD and DRIVEMANAGER or in binary form in the bar graph (KP200):



Hexadecimal: Parameter 360-DISP = IOSTA (subject area _36KP)

Binary: Parameter 361-BARG = IOSTA (subject area _36KP)

(1) Actuals in the VAL menu
(2) Binary representation in the bar graph

Figure 5.56 Representation of states via KEYPAD KP200

Status word 419-IOSTA

Bit	I/O	Function	DISP	BARG 9 8 7 6 5 4 3 2 1 0
0	ENPO	Digital hardware enable input	0001H	▯▯▯▯▯▯▯▯▯▮
1	ISD00	Digital input	0002H	▯▯▯▯▯▯▯▯▮▯
2	ISD01	Digital input	0004H	▯▯▯▯▯▯▯▮▯▯
3	ISD02	Digital input	0008H	▯▯▯▯▯▯▮▯▯▯
4	ISD03	Digital input	0010H	▯▯▯▯▯▮▯▯▯▯
5	OSD00	Digital output	0020H	▯▯▯▯▮▯▯▯▯▯
6	OSD01	Digital output	0040H	▯▯▯▮▯▯▯▯▯▯
7	OSD02	Digital output (relay)	0080H	▯▯▮▯▯▯▯▯▯▯
8	ISA00	Analog input in digital function	0100H	▯▮▯▯▯▯▯▯▯▯
9	ISA01	Analog input in digital function	0200H	▮▯▯▯▯▯▯▯▯▯

Table 5.64 Status word IOSTA in subject area VAL

Status word 419-IOSTA for factory setting DRV_1 with ENPO = 0 (off)

Input / output	Function [input/output]	DISP	BARG 9 8 7 6 5 4 3 2 1 0
ISD00/OSD02	Start clockwise/ready to start	0082H	▯▯▮▯▯▯▯▯▮▯
ISD01/OSD02	Start anti-clockwise/ready to start	0084H	▯▯▮▯▯▯▯▮▯▯
ISD02/OSD02	Slow jog/ready to start	0088H	▯▯▮▯▯▯▮▯▯▯
ISD03/OSD02	Not assigned/ready to start	0090H	▯▯▮▯▯▮▯▯▯▯

Table 5.65 Status word IOSTA in subject area VAL

Digital output OSD02 operates the relay when the inverter is "ready to start". This is indicated by bit 7 in the bar graph and hex value 0080H on the display.

5.3.9 _50WA-Warning messages

Function	Effect
• When programmable limit values are exceeded for various actuals of the inverter module or of the motor a warning is delivered.	• An impending fault in the drive system is signalled in good time to the system control.

Warning messages are automatically reset as soon as the cause of the warning no longer exists. The warning message is sent via the digital outputs, and at the same time the actual value to be monitored for the warning is also defined.

1.

2.

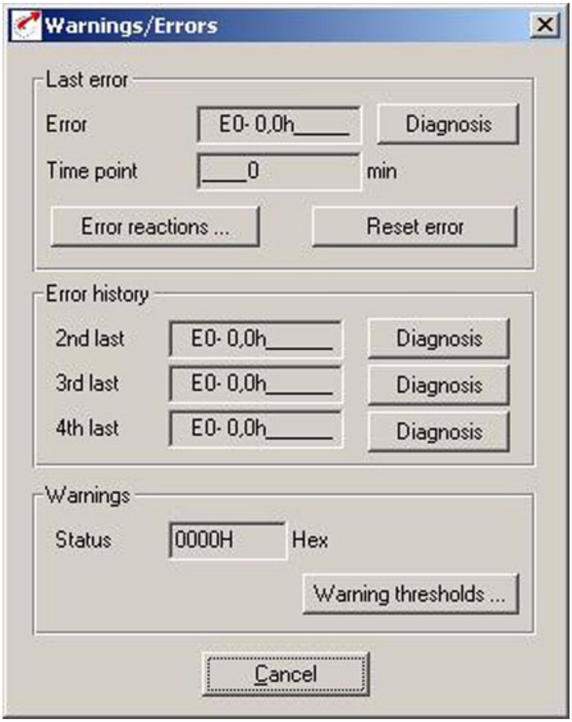


Figure 5.57 "Error/Warning" tab

3.

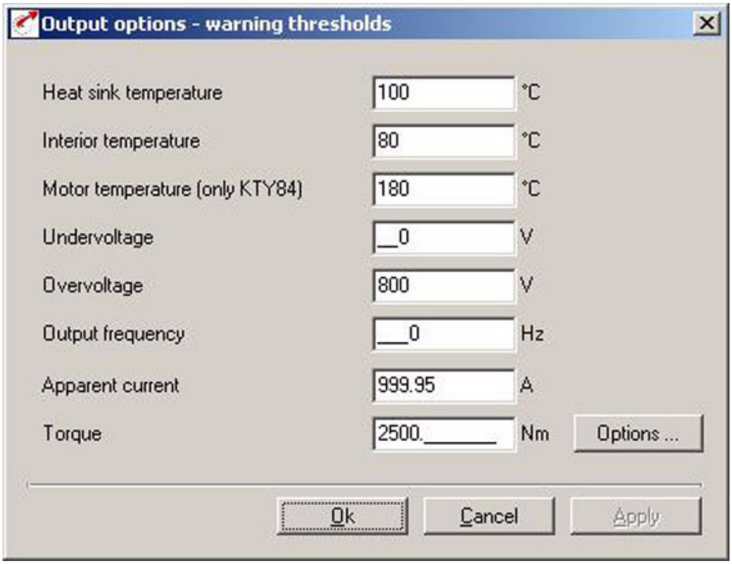


Figure 5.58 Warning thresholds

Warning messages

Parameter	Function	Value range	FS	Unit	Online
120-WRN	Status word, warnings	0000 .... FFFF		Hex	✔
500-WLTI	Device temperature warning threshold	5 ... 100	100	°C	✔
501-WLTD	Interior temperature warning threshold	5 ... 80	80	°C	✔
502-WLTM	Motor temperature warning threshold	5 ... 250	180	°C	✔
503-WLUV	Undervoltage warning threshold	0 ... 800	0	V	✔
504-WLOV	Overvoltage warning threshold	0 ... 800	800	V	✔
505-WLF	Frequency warning threshold	0 ... 1600	0	Hz	✔
506-WLIS	Apparent current warning threshold	0 ... 999.95	999.95	A	✔
507-WLTR	Torque warning threshold (SFC and FOR only)	0 ... 2500	2500	Nm	✔
508-TWTQ	Switch-on delay for torque warning threshold	0 ... 60	1	s	

Table 5.66 Parameters from subject area _50WA Warning messages

Explanatory notes

- Any warning can be delivered at any digital output.
- The motor temperature warning (WLTM) indicates a motor overload.
- The device temperature warning (WLTI) takes the temperature value from the sensor on the heat sink on the power stage transistors or, in the case of small inverter modules, directly from the power stage module.
- Owing to high breakaway and startup torques, it may be necessary to activate the torque warning threshold only after the threshold value has been exceeded for a period of time. This can be done with parameter 508-TWTQ "Switch-on delay for torque warning threshold".

- Inadequate or excessive DC-link voltage triggers the undervoltage (WLUV) or overvoltage (WLOV) warning as appropriate.
- The frequency warning relates to the current output frequency of the inverter module.
- The status word 120-WRN is formed from the current warning messages.

Note: The warning messages are not displayed in the DRIVEMANAGER. They can be evaluated in hexadecimal coding in parameter 120-WRN.

A listing of the error and warning messages displayed in the DRIVEMANAGER is given in the Appendix.

Warning messages are assigned a hysteresis:

Physical variable	Hysteresis
Voltages	Undervoltage - 0 V / + 10 V Overvoltage - 10 V / + 10 V
Temperature	- 0 °C / + 5 °C
Frequency	+ 0 Hz / - 1 Hz

Table 5.67 Hysteresis of warning messages

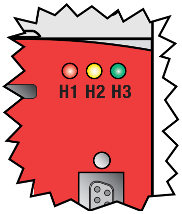
Status word 120-WRN

Warning	Function	Hex value	Bit
WOTI	Warning message when heat sink temperature has exceeded value in parameter 500-WLTI	0001H	0
WOTD	Warning message when interior temperature has exceeded value in parameter 501-WLTD	0002H	1
WOTM	Warning message when motor temperature has exceeded value in parameter 502-WLTM	0004H	2
WOV	Warning message when DC-link voltage has exceeded value in parameter 504-WLOV	0008H	3
WUV	Warning message when DC-link voltage has fallen below value in parameter 503-WLUV	0010H	4
WFOUT	Warning message when output frequency has exceeded value in parameter 505-WLF	0020H	5
WIS	Warning message when apparent current has exceeded value in parameter 506-WLIS	0040H	6
WIIT	Warning message when I^2*t integrator of device is active	0080H	7
WFDIG	Warning message from slave when reference value from master is faulty in Master/ Slave operation	0100H	8
WIT	Warning message when Ixt integrator of motor is active	0200H	9
WTQ	Warning message when torque has exceeded value in parameter 507-WLTQ	0400H	10

Table 5.68 Hexadecimal representation of warning messages

5.3.10 _51ER-Error messages

Function	Effect
• Display of faults in the drive system	• Quick location of the cause of the error and definition of the response of the drive to an error



Error messages can be detected and evaluated by way of the status LEDs of the inverter module. If the red LED H1 is flashing an error has occurred.

The response to an error can be parameterized according to the cause of the error.

Flash code of red LED (H1)	Display KeyPad	Error cause
1x	E-CPU	Collective error message
2x	E-OFF	Undervoltage shut-off
3x	E-OC	Current overload shut-off
4x	E-OV	Overvoltage shut-off
5x	E-OLM	Motor overloaded
6x	E-OLI	Device overloaded
7x	E-OTM	Motor temperature too high
8x	E-OTI	Heat sink/device temperature too high

Table 5.69 Error message signalling

Note: For more error numbers and possible causes refer to the Appendix.

Acknowledgment and resetting of errors

Errors can be acknowledged and reset in various ways:

- Rising edge at digital input ENPO
- Rising edge at a programmable digital input with setting of the function selector to RSERR
- Write value 1 to parameter 74-ERES via bus system

Parameters for error messages

Parameter	Function	Value range	FS	Unit	Online
74-ERES	Reset device errors	STOP/START	STOP		✔
140-R-RNM	Response to error in setting an operation mode	RESET	RESET		
510-R-SIO	Response to SIO watchdog	STOP ... RESET	STOP		✔
511-R-CPU	Response to CPU error	RESET	RESET		✔
512-R-OFF	Response to undervoltage	STOP ... RESET	STOP		✔
513-R-OC	Response to current overload	STOP ... RESET	LOCK		✔
514-R-OV	Response to overvoltage	STOP ... RESET	LOCK		✔
515-R-OLI	Response to Ixt cut-off of inverter	STOP ... RESET	LOCK		✔
516-R-OTM	Response to motor overheating	0 ... RESET	LOCK		✔
517-R-OTI	Response to inverter module overheating	STOP ... RESET	LOCK		✔
518-R-SC	Response to error during initial commissioning	LOCK ... RESET	LOCK		✔
519-R-OLM	Response to motor I^2xt cut-off	STOP ... RESET	LOCK		✔
520-R-PLS	Response to software runtime error	RESET	RESET		4
521-R-PAR	Response to faulty parameter list	RESET	RESET		4
522-R-FLT	Response to floating point error	RESET	RESET		4
523-R-PWR	Response to unknown power pack	RESET	RESET		4
524-R-EXT	Response to external error message	STOP ... RESET	STOP		✔
525-R-USR	Response to modified software error message	STOP ... RESET	STOP		✔
526-R-OP1	Response to error in option module slot 1	STOP ... RESET	STOP		✔
527-R-OP2	Response to error in option module slot 2	STOP ... RESET	STOP		✔
529-R-WBK	Response to wire break ISA00 at 4 ... 20mA	STOP ... RESET	STOP		✔
530-R-EEP	Response to memory error in FLASHEPROM	RESET	RESET		
531-EFSCL	Ground fault detection response threshold scaling	0 ... 200	0	%	✔
532-R-PF	Response after DC-link buffering	STOP ... RESET	STOP		✔
533-R-FDG	Response to reference coupling transmission error	STOP ... RESET	STOP		✔
534-R-LSW	Response to reversed limit switches	1 ... 3	LOCK		✔
535-R-PRC	Response to exceeding of maximum control deviation (PR)	STOP ... RESET	LOCK		✔
536-R-FLW	Response to exceeding of maximum frequency deviation	STOP ... RESET	LOCK		✔

Table 5.70 Parameters from subject area _51ER Error messages

Parameter	Function	Value range	FS	Unit	Online
543-R-OL5 from SW 2.0	Response to Ixt shut-off below 5 Hz	STOP ... RESET	LOCK		✔
545-TEOC	Time delay of error message E-OC-1	0 ... 1000	0	ms	✔
94-TERR	System time on occurrence of last error	0 ... 65535	0	h	
95-ERR1	Last error	0 ... 65535	0	h	
96-ERR2	Second-last error	0 ... 65535	0	h	
97-ERR3	Third-last error	0 ... 65535	0	h	
98-ERR4	Fourth-last error	0 ... 65535	0	h	

Table 5.70 Parameters from subject area _51ER Error messages

Settings for 140-RNM to 534-R-LSW

BUS	KP/DM	Function
0	WRN	No response
1	STOP	Disable power stage. If the error is no longer present, the device can be restarted after confirming the error message. If auto-start is programmed (7-AUTO=ON), the device starts automatically following the reset.
2	LOCK	Disable power stage and secure against restarting. If the error is no longer present, the device can be restarted after confirming the error message. If auto-start is programmed (7-AUTO=ON), automatic starting of the device is prevented.
3	RESET	Disable power stages and wait for error reset by power down/up. **NOTE:** This error can **only** be reset by powering down and back up! After a reset the device runs through an initialization and self-test phase. During this time it cuts bus connections and detects no signal changes at the inputs. Additionally, the outputs return to their hardware home positions. Conclusion of an initialization and self-test phase can be indicated by way of a digital output with "Device ready" (see section 5.2.4 "_240D-Digital outputs", setting C_RDY). If the error is no longer present, the device indicates "ready" following the reset and can be restarted. If auto-start is programmed (7-AUTO=ON), the device starts automatically.

Table 5.71 Response to error

Explanatory notes

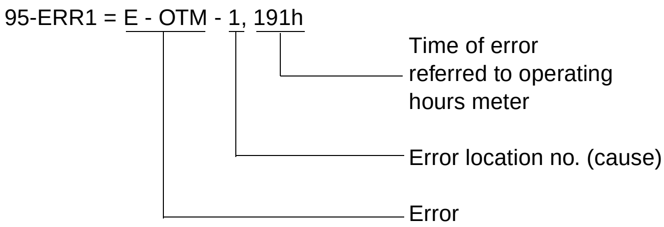
- The grey highlighted parameters cannot be set, they are for display purposes only.
- The response to a ground fault detection error or an insulation error is defined by parameter 513-R-OC "Response to current overload".

Presentation of error history

Parameters 95-ERR1 to 98-ERR4 store the error with its location and number and the time of error referred to the operating hours meter.

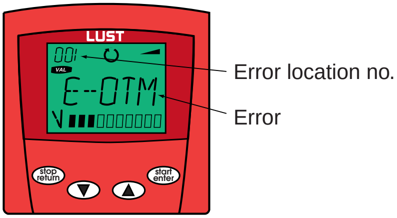
After each error the error memory scrolls on and error parameter 95-ERR1 displays the last error.

Example of viewing on DRIVEMANAGER:



Note: A listing of the error and warning messages displayed in the DRIVEMANAGER is given in Appendix B.

Example of viewing via KeyPad KP200:



E-OC time limited error checkback

When switching in the motor cable at the motor output of the frequency inverter, if the power stage is active or the motor is still excited high voltages and currents will occur for a short period of time. Although they cannot destroy the frequency inverter power stage, they do produce error message E-OC-1. The power stage is disabled as soon as the overcurrent is detected with message E-OC-1. The programmable time delay delays the error message, and at the end of the delay time a check is made whether the hardware enable ENPO is still set. If it is, the error message is signalled.

Fault current monitoring by differential current monitoring

The implemented differential current monitoring is based on typical RCM differential current protection devices.

Based on the scaleable response threshold of the ground fault detector by way of parameter 531-EFSCL, fault currents can be detected and the device power stage can be disabled. Error message E-OC-110 is delivered.

The basic principle of electrical engineering requires that all conductors (except grounding leads) are routed through a converter. In an error-free system the sum total of all currents is then equal to zero, so no differential current is evaluated by the software via the current sensors of the inverter.

As a result, symmetrical insulation errors occurring in all motor cables against PE or ground cannot be detected by the differential current monitor.

5.4 Bus operation and option modules

This Manual details only the software parameters of the CDA3000 inverter module. For more details on the field bus systems refer to the relevant documents relating to the option modules.

5.4.1 _55LB-LUSTBUS

Function	Effect
• Creation of the device addresses and baud rate for the service and diagnostic interface	• Adaptation of the serial interface (RS232) to a PC with the DRIVEMANAGER software or the KEYPAD KP200

Parameters for LUSTBUS

Parameter	Function	Value range	FS	Unit	Online
81-SBAUD	LUSTBUS transfer rate	1200 2400 4800 9600 19200 28800 57600	57600	Bit/s	4
82-SADDR	LUSTBUS device address	0 ... 30	1		
83-SDMMY	LUSTBUS dummy parameter	0 ... 255	0		
84-SWDGT	LUSTBUS watchdog time setting	0.00 ... 20.00	0,00	s	4
85-SERR	LUSTBUS error status word	00H ... FFH	00 Hex		4
550-SSTAT	Status word of serial interface	0 ... 65535	0		4
551-SCNTL	Control word of serial interface	0000H ... FFFFH	0000Hex		4

Table 5.72 Parameters from subject area _55LB LUSTBUS

Explanatory notes

- If only one inverter module is operated on the DRIVEMANAGER no device address need be set. For more than one device, different address parameters must be set.
- The LUSTBUS watchdog time setting is deactivated to 0.0 s at the factory.

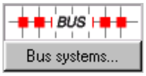
Note: Where there are several devices on a bus system, to provide a clearer differentiation between them it is advisable to enter a symbolic name in each device by way of parameter 130-Name (see section 5.3.7 "Device data").

5.4.2 _57OP-Option modules

Function	Effect
• Setting of device addresses and baud rate for the communication modules • Configuration of process data for the communication modules • Diagnostic data for field bus operation	• Adaptation of the option modules to the application

An up-to-date overview of the option modules is given in the CDA3000 Catalogue.

1.



2.

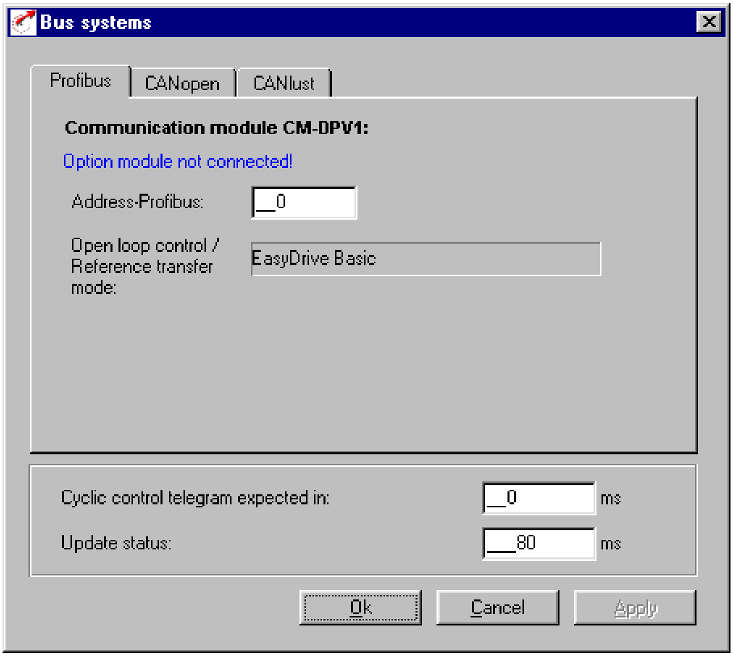
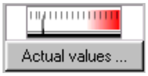


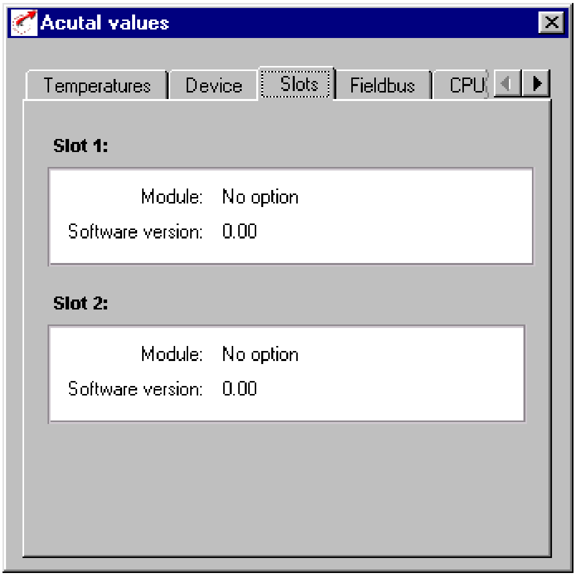
Figure 5.59 Bus systems

The status and control word can be monitored from the Actuals screen, as can the option slot assignment.

1.



2.



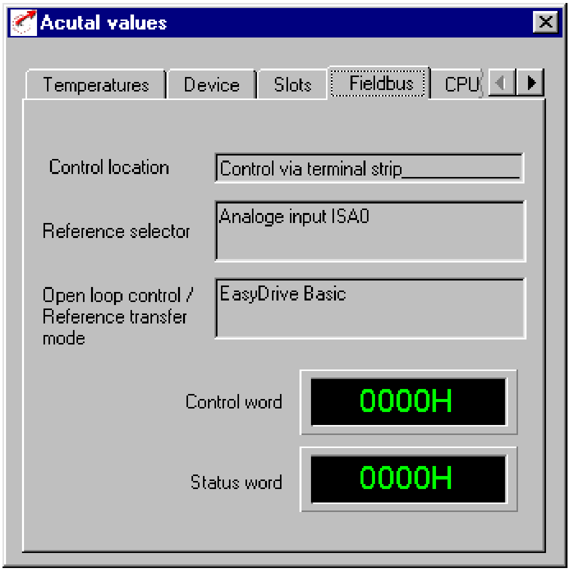


Figure 5.60 Actuals of bus systems

Overview of option modules

Order designation	Option modules	Summary description
CM-CAN1	CAN_{Lust}	Conforming to CiA Draft Standard 102
CM-CAN2	CAN_{open}	Conforming to CiA Draft Standard 301/402
CM-DPV1	PROFIBUS-DP	Conforming to EN 50170 / DIN 19245
UM-8I40	I/O module	Terminal expansion module with 8 inputs and 4 outputs

Table 5.73 Overview of option modules

Parameters for option modules

Parameter	Function	Value range	FS	Unit	Online
489-CLBDR	CAN_{LUST} controller baud rate	25 ... 500	500		
492-CACNF	CAN_{Lust} control/reference transfer mode	0 ... 4	4		✔
570-CAMOD	CAN_{Lust} option module function selection	Slave/Master	Slave		

Table 5.74 Parameters from subject area _570P Option modules

Parameter	Function	Value range	FS	Unit	Online
571-CLADR	CAN bus Device address	0 ... 29	0		
572-CASTA	CAN_{LUST} bus status word	0000H ... FFFFH	0000 Hex		
573-CACTR	CAN bus control word	0000H ... FFFFH	0000 Hex		✔
574-CAWDG	CAN bus watchdog time	0 ... 255	0	ms	✔
575-CASCY	Sampling time for status message	1 ... 32000	80	ms	✔
576-OP1RV	SW version of communication module at option slot	*	0.00		
577-OP2RV		*	0.00		
578-OPTN2	Assignment of option module	*	NONE		
579-OPTN1	Assignment of option module	*	NONE		
580-COADR	CAN_{open} device address	1 ... 127	1		
581-COBDR	CAN_{open} controller baud rate	25 ... 1000	500		
582-CPADR	Profibus DP device address	0 ... 127	0		
583-IOEXT	Status word of user module	0000H ... FFFFH	0000 Hex		

* module-dependent

Table 5.74 Parameters from subject area _570P Option modules

Explanatory notes

- All option modules communicate with the CDA3000 inverter module based on the standard of the CAN_{Lust} protocol.
- The watchdog monitoring is deactivate to 0 ms at the factory.

Baud rates of CAN controllers

CAN system	Parameter	Values [bit/s]
CAN_{LUST}	489-CLBDR	25, 50, 75, 125, 250, 500
CAN_{open}	581-COBDR	25, 125, 500, 1000

Table 5.75 Transmission speed of CAN controllers

Status word of user module 583-IOEXT

I/O	Function	Hex value	Bit=1
-	Module detected and logged onto bus	8000H	15
IED00	Digital input	8001H	15/0
IED01	Digital input	8002H	15/1
IED02	Digital input	8004H	15/2
IED03	Digital input	8008H	15/3
IED04	Digital input	8010H	15/4
IED05	Digital input	8020H	15/5
IED06	Digital input	8040H	15/6
IED07	Digital input	8080H	15/7
OED00	Digital output	8100H	15/8
OED01	Digital output	8200H	15/9
OED02	Digital output	8400H	15/10
OED03	Digital output	8800H	15/11

Table 5.76 Status word IOEXT of user module

Note: Signal evaluation of the digital inputs on the CDA3000 inverter module is state-controlled and on the terminal expansion module it is edge-controlled.

5.5 Open-loop and closed-loop control

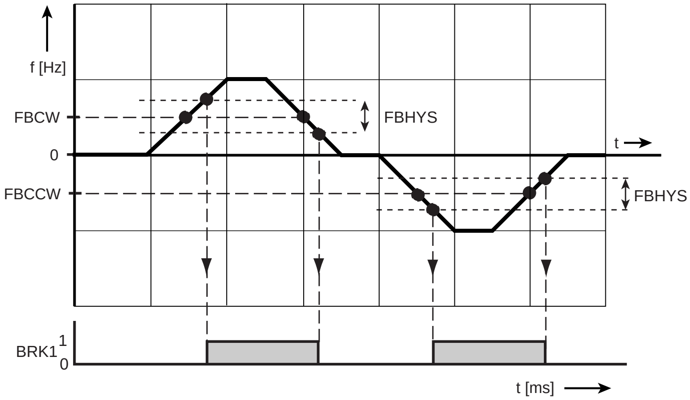
The following software functions are used in both the open-loop and the closed-loop control modes.

5.5.1 _31MB-Motor holding brake

Function	Effect
• An electromechanical holding brake can be actuated depending on a limit value • Optionally, release and engaging of the holding brake can be timed.	• The holding brake engages when a minimum frequency limit is infringed.

Motor holding brake BRK1

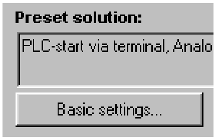
The diagram below represents the function of the motor holding brake within the programmable frequency range. The brake can be released by a digital output set by the function selector dependent on a reference.



BRK1 Digital output

Figure 5.61 Frequency ranges of the holding brake in setting BRK1

1.



2.

3.

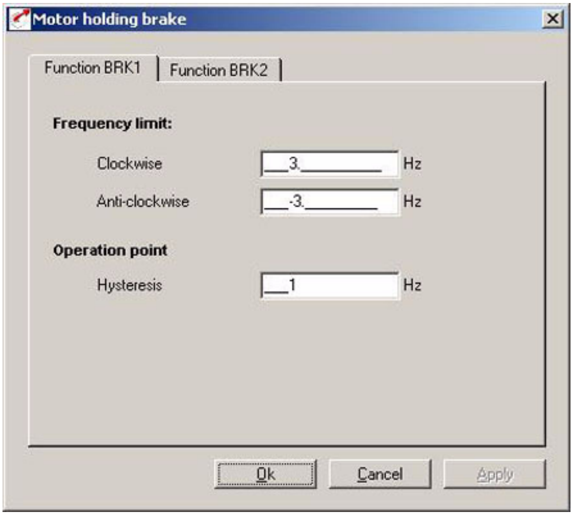


Figure 5.62 "BRK1 function" tab

Parameters for motor holding brake BRK1

Parameter	Function	Value range	FS	Unit	Online
310-FBCW	BRK1: Frequency limit for motor brake (clockwise)	0 ... 1600	3	Hz	✔
311-FBCCW	BRK1: Frequency limit for motor brake (anti-clockwise)	-1600 ... 0	-3	Hz	✔
312-FBHYS	BRK1: Switch-on hysteresis of motor holding brake	0 ... 1600	1	Hz	✔

Table 5.77 Parameters from subject area _31MB Motor holding brake BRK1

Settings of digital outputs for motor holding brake BRK1

Setting	Function	FOS00	FOS01	FOS02	FOE0x
BRK1	Output is set when the control reference has exceeded the value in parameter FBCxx (clockwise: FBCW, anti-clockwise: FBCCW).	✔	✔	✔	✔

Table 5.78 Settings for FOxxx of digital outputs for motor holding brake BRK1

Explanatory notes

- The frequency limit for engagement/release of the holding brake can be set independently for clockwise and anti-clockwise running. Pay attention to the switching hysteresis.
- The switching points for the motor holding brake BRK1 are linked to the reference value in all control modes.

Motor holding brake BRK2

When the brake functionality BRK2 is selected via a digital output, the functionality is automatically adjusted depending on the chosen control mode. Allowance can be made for the time for release or engagement of the motor holding brake by means of separate timer elements.

Control mode	Features, braking function BRK2
VFC (SFC)*	• Brake actuation switching points dependent on control reference • Momentary build-up by operation with slip frequency of motor with motor holding brake closed
FOR	• Brake actuation switching points dependent on the control actual value (rotor frequency) • Momentary build-up at standstill with motor holding brake closed
*) Also refer to the safety note presented below and the latest supplementary sheet accompanying the CDA3000.	

Table 5.79 Features of the BRK2 braking function dependent on control mode

Attention! In SFC mode only a limited torque is available under regenerative load. Consequently, SFC cannot be used for lifting gear, for example. For more details refer to the latest supplementary sheet accompanying the CDA3000 frequency inverter.

1.

2.

3.

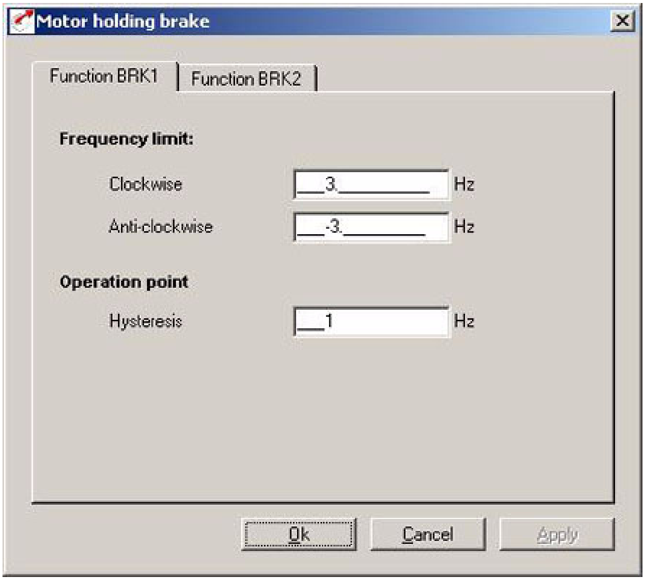


Figure 5.63 "BRK2 function" tab

Parameters for motor holding brake BRK2

Parameter	Function	Value range	FS	Unit	Online
313-SSCW	BRK2: Frequency limit for motor brake (clockwise)	0.125 ... 200	*	Hz	✔
314-SSCCW	BRK2: Frequency limit for motor brake (anti-clockwise)	0.125 ... 200	*	Hz	✔
315-SSHYS	BRK2: Frequency hysteresis for motor brake	0.125 ... 100	*	Hz	✔
316-TREF	BRK2: Delay of acceleration in holding brake function	10 ... 10,000	10	ms	✔
317-TCTRL	BRK2: Delay of shut-off in holding brake function	10 ... 10,000	10	ms	✔

Table 5.80 Parameters from subject area _31MB Motor holding brake BRK2

Setting of digital outputs for motor holding brake BRK2

Setting	Function	FOS01	FOS02	FOS03	FOE0x
BRK2	Output is set if, in VFC (SFC), the control reference or, in FOR, the control actual value has exceeded the value in parameter SSCxx (clockwise: SSCW, anti-clockwise: SSCCW)	✔	✔	✔	✔

Table 5.81 Settings for FOxxx of digital outputs for motor holding brake BRK2

Explanatory notes

- Values marked by an asterisk (*) are calculated automatically during auto-tuning of the frequency inverter and entered in the parameters.
- The frequency limit in control mode VFC (SFC) for engagement/ release of the holding brake can be set independently for clockwise and anti-clockwise running. Pay attention to the switching hysteresis.
- The BRK2 brake actuation does not work in DC braking.
- It is not possible to reconfigure a digital output from or to setting BRK2 online. To set the parameters the power stage must be inactive.
- In conjunction with brake actuation BRK2 with the motor protection control ENMO, the timer element 247-TENMO "Time between motor contactor and active control" (see section 5.2.4 "_24OD-Digital outputs") is run before and after brake actuation.
- The value for the motor brake frequency hysteresis is calculated from 0.5 times the slip frequency of the motor.
- The frequencies for anti-clockwise and clockwise are attuned to the slip frequency of the motor.
- In the factory setting the frequency limit and hysteresis are configured to values for an IEC standard motor with a ratio of inverter to motor of 1:1.

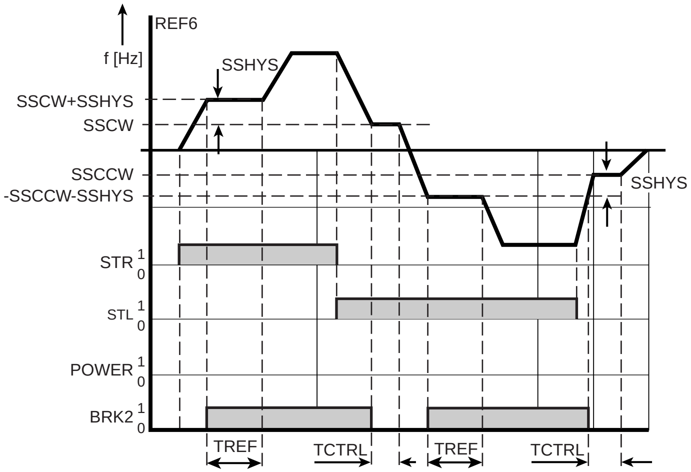
BRK2 in control mode VFC (SFC)

During initial commissioning the following parameters are preset automatically depending on motor during auto-tuning.

Parameter	Function	Value
313-SSCW	BRK2: Frequency limit for motor brake (clockwise)	Slip frequency
314-SSCCW	BRK2: Frequency limit for motor brake (anti-clockwise)	Slip frequency
315-SSHYS	BRK2: Frequency hysteresis for motor brake	Slip frequency * hysteresis factor

Table 5.82 Parameter preset for BRK2 by auto-tuning in motor identification

Time diagram of motor holding brake BRK2 in VFC (SFC)



POWER Frequency inverter power stage
BRK2 Digital output

Figure 5.64 Function of motor holding brake BRK2 in VFC (SFC)

Explanatory notes

Reference > 313-SSCW or 314-SSCCW

- In the event of reference input above the programmable frequencies added to the amount of 315-SSHYS, the drive accelerates to the frequency limit + hysteresis value and the reference is held until the time 316-TREF has elapsed. The 316-TREF time parameters should be set to those of the brake.
- At the end of the time 316-TREF the brake should have released and the reference is accelerated to the currently set reference above the frequency limit + hysteresis value.
- The programmable frequency limit is set to the slip frequency of the motor and ensures that the motor builds up a torque against the brake.
- Consequently, a torque is available for the load as soon as the brake has been released.

Reference < 313-SSCW or 314-SSCCW

- In the event of reference input below the programmable frequency limit, the reference is held at the frequency limit (313-SSCW, 314-SSCCW) until the time 317-TCTRL has elapsed. The 317-TCTRL time parameters should be set to the release time of the brake.
- At the end of the time 317-TCTRL the brake should have safely engaged. Reference values below the frequency limit configured to the slip frequency produce inadequate torques.
- As a result, the brake secures the load if there is insufficient torque available when operating the motor below the slip frequency.

BRK2 in control mode FOR

For the motor holding brake BRK2 parameter 315-SSHYS "BRK2: Frequency hysteresis for motor holding brake" must be adjusted manually.

The following parameters of the BRK2 functionality in FOR can be activated:

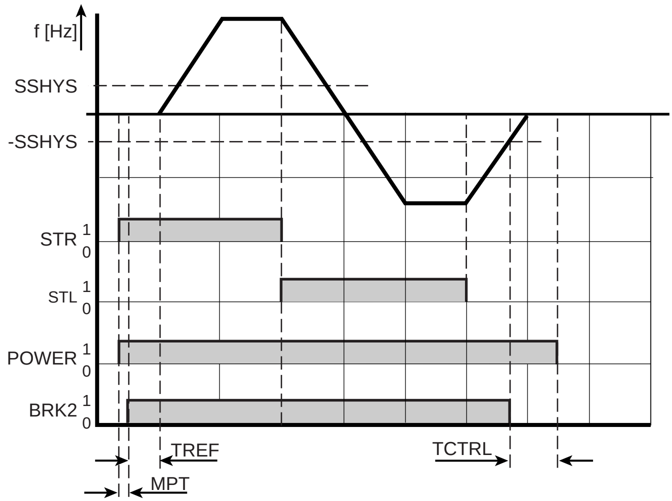
Parameter	Function	Activatable
313-SSCW	BRK2: Frequency limit for motor brake (clockwise)	⊘
314-SSCCW	BRK2: Frequency limit for motor brake (anti-clockwise)	⊘

Table 5.83 Active parameters of motor holding brake BRK2 in control mode FOR

Parameter	Function	Activatable
315-SSHYS	BRK2: Frequency hysteresis for motor brake	✔
316-TREF	BRK2: Delay of acceleration in holding brake function	✔
317-TCTRL	BRK2: Delay of shut-off in holding brake function	✔

Table 5.83 Active parameters of motor holding brake BRK2 in control mode FOR

Time diagram of motor holding brake BRK2 in FOR



POWER Inverter power stage
BRK2 Digital output
MPT Motor flux build-up phase

Figure 5.65 Function of motor holding brake BRK2 in control mode FOR

Explanatory notes

- Reference ≠ 0 Hz

  In the start phase the motor holding brake is switched depending on the reference value. If the current reference value is ≠ 0 Hz, the magnetization phase to build up flux in the motor is run for the time 774-MPT (see section 5.5.14 "_77MP-Remagnetization"). Then the digital output = BRK2 is activated and the timer element 316-TREF is activated. The 316-TREF time parameters should be set to the pick-up time of the brake. At the end of the time 316-TREF the brake should be released and the drive accelerates to the preset reference value. At the end of the time 316-TREF the functionality of the motor holding brake BRK2, the "reference reached" message and the standstill recognition are determined by the actual value of the rotor.

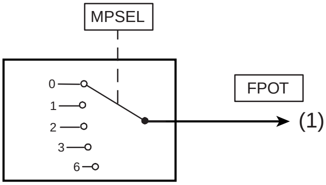
- Reference = 0 Hz

  If at reference = 0 Hz the actual value is in the configured "reference-reached window" of parameter 230-REF_R, motor standstill is detected. Simultaneously with reference input = 0 Hz, when the actual value of the frequency limit 315-SSHYS is reached the timer element 317-TCTRL is started. The 317-TCTRL time parameters should be set to the release time of the brake. At the end of the time 317-TCTRL the brake should have safely engaged and hold the load. Finally the power stage is disabled.

- The control reference and actual values can be compared to activate an error message. The limit value for exceeding of the maximum frequency deviation (tracking error) is determined by parameter 751-MXFLW in subject area "_79EN-Encoder evaluation". The response is defined with parameter 535-R-FLW in subject area "_51ER-Error messages".

5.5.2 _32MP-MOP function

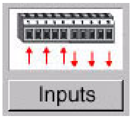
Function	Effect
• With two inputs the reference can be increased or reduced in linear form	• Simple adaptation of the motor speed to the process



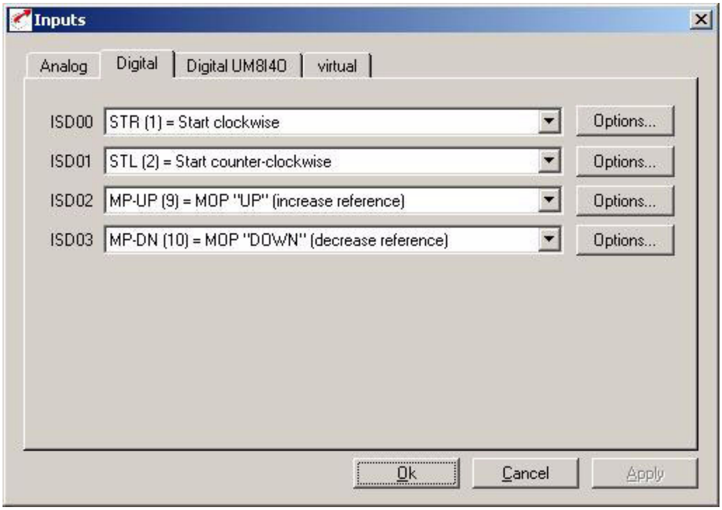
(1) Active MOP function in reference source FPOT

Figure 5.66 Function block: MOP function selector

1.



2.



1 2 3 4 5 6 A
DE EN

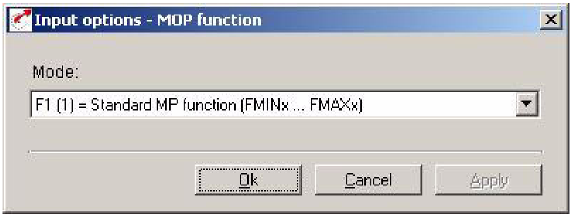


Figure 5.67 MOP functions

Parameters for MOP function

Parameter	Function	Value range	FS	Unit	Online
320-MPSEL	Configuration for motor operated potentiometer	0 ... 6	0		✔

Table 5.84 Parameters from subject area _32MP MOP function

Settings for MOP function 320-MPSEL

BUS	KP/DM	Function
0	OFF	No function
1	F1	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN.
2	F2	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. If both inputs are set simultaneously, the offset speed is reset to 0 Hz.
3	F3	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. In case of failure of the mains voltage the offset speed is stored.
4	F4	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. If both inputs are set simultaneously, the offset speed is reset to 0 Hz. In case of failure of the mains voltage the offset speed is stored.
5	F5	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. The offset speed is reset to 0 Hz when the start command is cancelled.
6	F6	Increase and reduce speed within limits FMINx ... FMAXx with inputs MP_UP and MP_DN. If both inputs are set simultaneously, the offset speed is reset to 0 Hz. The offset speed is reset to 0 Hz when the start command is cancelled.

Table 5.85 Settings for 320-MPSEL MOP function

Setting of inputs for MOP functions

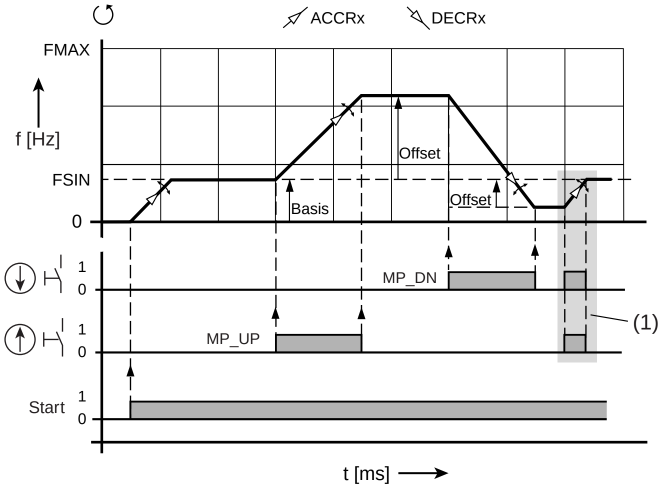
Note: In terminal operation the function selector of one digital or one analog input (in digital function) is configured with

MP-UP = increase reference
MP-DN = reduce reference

(see section 5.2 "Inputs and outputs").

Example: Setting F1 of MOP function

A digital potentiometer is operated by way of two digital inputs. One input reduces the reference value, the other increases it. At the analog input ISA0x a base value can be set as the analog speed reference FSIN, so the digital inputs act as an offset. The MOP function assigns the reference source FPOT a reference value.



(1) Reset reference to base value

Figure 5.68 Basic function with reset to base value (corresponds to setting F1 in Table 5.85)

Definitions

Base value	Analog speed reference set at input ISAxx
Offset	Portion of the increase or decrease in the base value, influenced by the inputs with the functions MP_UP and MP_DN
ISDxx = MP_UP	Offset input for reference increase
ISDxx = MP_DN	Offset input for reference decrease

5.5.3 _59DP-Driving profile generator

Function	Effect
• Setting of the acceleration and deceleration ramps • Setting of a smoothing of the start and end point of the linear ramp	• Adaptation of the motor dynamics to the application • Reduced drive bucking

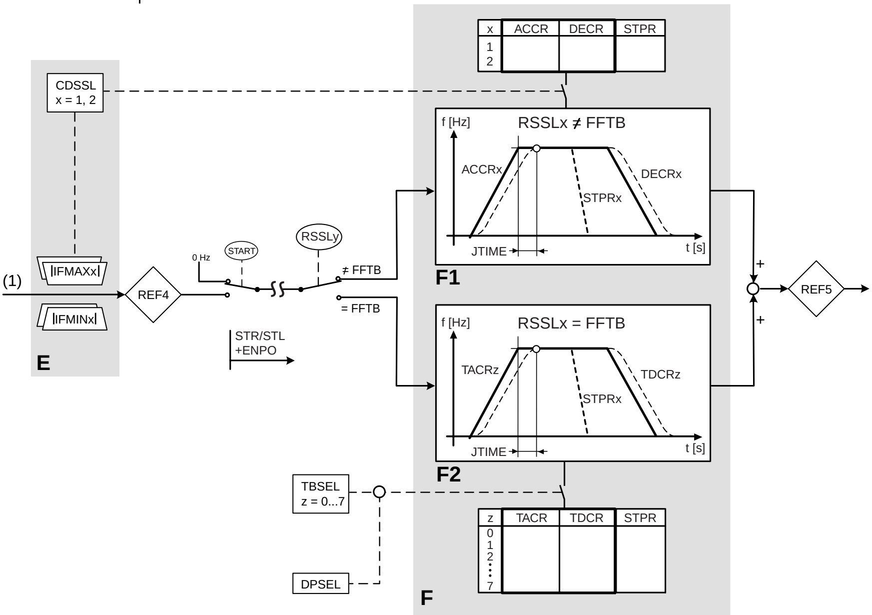
Driving profile generator

The reference limiter is inserted upstream of the driving profile generator. By way of the reference selector the reference sources are selected, and thus indirectly in the driving profile generator the general ramp generator or table-supported ramp generator. The driving profile generator generates the appropriate acceleration and deceleration ramps to attain the specified frequency reference. The braking ramp STPRx is effective throughout the entire driving profile generator if it is activated with STPRx ≠ 0.

- Normal, non-table-supported driving sets (RSSLx ≠ FFTB):
  Ramp generator with characteristic data sets, selection of characteristic data set by way of characteristic data selector 650-CDSSL
- Table-supported driving sets (RSSLx = FFTB):
  Driving sets from a stored table, selection of data sets by way of table selector 624-TBSEL

Note: As from firmware V3.2, the ramps of the driving profile generator can also be activated uniformly for the driving sets.
As a result the table-supported ramps are deactivated (see section 5.5.5 "_60TB-Driving sets").

Driving profile generator block diagram



E Reference limitation (subject area "_30OL-Frequency limitation")
F Driving profile generator
F1 Ramp generator, normal (see Table 5.87)
Smoothing adjustable only after interim reference REF5, visible as from REF6
F2 Table-supported ramp generator (subject area "_60TB-Driving sets")
(1) Frequency reference

Figure 5.69 Parameters in subject area _59DP (cf. reference structure Figure 5.31)

Ramp generator

The ramp generator can smooth linear ramps at the end points in order to limit bucking.

Movement mode	Setting
dynamic, bucking	JTIME = 0, linear ramps without smoothing
Low impact on mechanism	JTIME ≠ 0, sinusoidal ramps based on smoothing by x [ms].

Table 5.86 Ramp generator

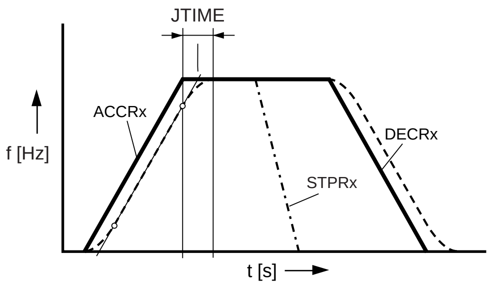


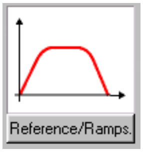
Figure 5.70 Driving profile of ramp generator

Sinusoidal ramps

As a result of the bucking limitation the acceleration and deceleration times are increased by the smoothing time JTIME. An emergency stop via the stop ramp STPRx is executed in linear mode - that is to say without bucking limitation - to keep the braking duration as short as possible.

Note: The mechanism is left heavily vibrated. Material fatigue due to load changes is reduced. A mechanism with play is subject to less deflection.

1.



2.

3.

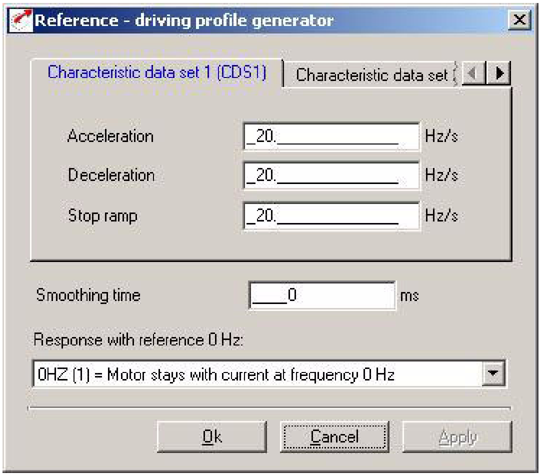


Figure 5.71 "Reference - Driving profile generator CDS1" tab

Parameters for the ramp generator

Parameter	Function	Value range	FS	Unit	Online
590-ACCR1	CDS1: Acceleration ramp	0 ... 999	20	Hz/s	✔*
591-ACCR2	CDS2: Acceleration ramp	0 ... 999	20	Hz/s	✔*
592-DECR1	CDS1: Deceleration ramp	0 ... 999	20	Hz/s	✔*
593-DECR2	CDS2: Deceleration ramp	0 ... 999	20	Hz/s	✔*
594-STPR1	CDS1: Stop ramp	0 ... 999	20	Hz/s	✔*
595-STPR2	CDS2: Stop ramp	0 ... 999	20	Hz/s	✔*
596-JTIME	Smoothing time of sinusoidal ramp	0 ... 10000	0	ms	
597-RF0	Response at reference value 0 Hz	OFF / 0 Hz	OFF	-	✔
* From firmware V. 2.10					

Table 5.87 Parameters from subject area _59DP Driving profile generator

Explanatory notes

- If one of the two ramps (acceleration ramp ACCRx, deceleration ramp DECRx) of a characteristic data set is set to 0 (zero), both ramps are inactive and the associated ramp parameter is likewise set automatically to 0.
- If one of the ramps (acceleration ramp ACCRx, deceleration ramp DECRx) of a characteristic data set is set to >0 Hz, and the second ramp still has the value 0 Hz, the second ramp is also automatically set to the value >0 Hz.
- The DC braking function has priority over the stop ramp STPRx.
- Standard control signals with the assignment of the ramps are set out in Table 5.39 (section 5.2.7).
- The ramp values can only be changed online as from firmware V. 2.10.
- The smoothing also affects the driving sets (section 5.5.5 "_60TB-Driving sets").

Note: Dynamic acceleration and deceleration results in high startup and braking currents. This also applies to the emergency stop by way of the stop ramp. In deceleration the motor drops into regenerative operation and increases the DC-link voltage (DCV).

Error messages in acceleration processes

Acceleration	Error	Remedy
Positive	• E-OC (current overload)	• Flatter ramp
	• E-OLI (inverter module I^2xt cut-off)	• Higher-powered inverter module
Negative	• E-OV (overvoltage)	• Flatter ramps
	• E-OLI (inverter module I^2xt cut-off)	• External braking resistor
	• E-OTI (inverter module overheating)	• Higher-powered inverter module

Table 5.88 Rectification of errors in acceleration processes

5.5.4 _27FF-Fixed frequencies

Function	Effect
• Setting of a fixed frequency per characteristic data set	• Operation of a drive in quick jog/slow jog driving profile • Simple reference input

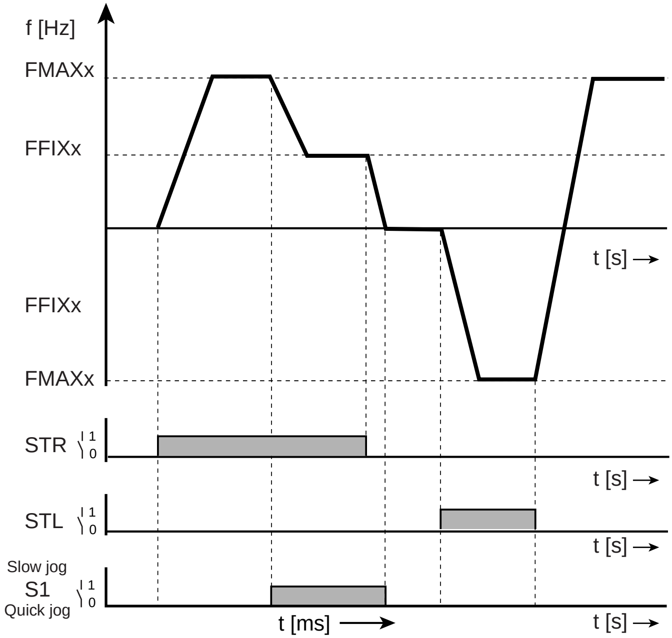
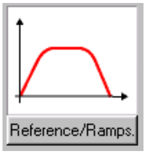


Figure 5.72 Fixed frequency for quick jog/slow jog application



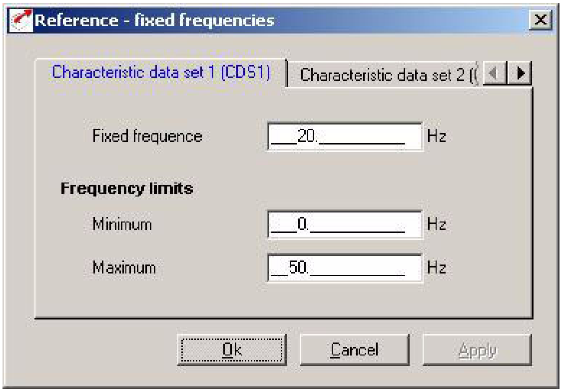


Figure 5.73 "Reference - fixed frequencies CDS1" tab

Parameters of the fixed frequencies

Parameter	Function	Value range	FS	Unit	Online
270-FFIX1	CDS1: Fixed frequency	-1600 ... 1600	20	Hz	✔
271-FFIX2	CDS2: Fixed frequency	-1600 ... 1600	20	Hz	✔

Table 5.89 Parameters from subject area _27FF Fixed frequencies

Explanatory notes

- The fixed frequency can be selected by way of the digital inputs. To do so, set the reference source in the reference structure to 280-RSSL1 = FFIX (see section 5.2.6 "_28RS-Reference structure").

5.5.5 _60TB-Driving sets

Function	Effect
• Setting of up to 8 fixed frequencies with driving set dependent acceleration and deceleration ramps • Selection of ramp generator	• Adaptation of the motor dynamics to the application • Ramp dependency of driving set or driving profile generator

A driving set contains a fixed frequency, which when the set is selected serves as the frequency reference, and an acceleration and deceleration ramp. Up to 8 driving sets can be stored in a table.

Initiation of an emergency stop by means of a braking ramp with parameter STPRx ≠ 0 disables the table-supported ramps and activates the braking ramp.

Note: Explanatory notes on the driving profile generator are given in section 5.5.3 "_59DP-Driving profile generator".

Example of application of the driving sets

Preconditions:

- Function selector of digital input ISD00: FIS00 = FFTB0
- Function selector of digital input ISD01: FIS01 = FFTB1

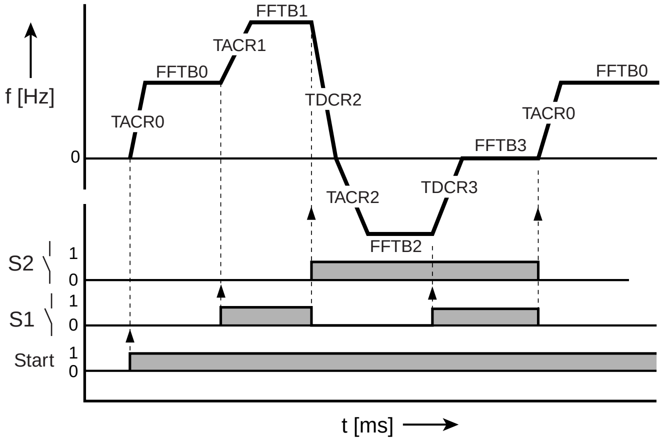


Figure 5.74 Example of driving sets with fixed frequencies

Selection of driving sets

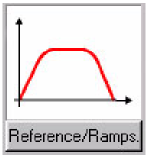
Driving set	FIxxx= FFTB2	FIxxx= FFTB1	FIxxx= FFTB0	Fixed frequency	Acceleration ramp	Deceleration ramp
0	0	0	0	FFTB0	TACR0	TDCR0
1	0	0	1	FFTB1	TACR1	TDCR1
2	0	1	0	FFTB2	TACR2	TDCR2
3	0	1	1	FFTB3	TACR3	TDCR3
4	1	0	0	FFTB4	TACR4	TDCR4
5	1	0	1	FFTB5	TACR5	TDCR5
6	1	1	0	FFTB6	TACR6	TDCR6
7	1	1	1	FFTB7	TACR7	TDCR7

Table 5.90 Selection of driving sets

The **driving sets** (rows in the table) are selected by way of:

- the inputs which are parameterized to switch to FFTBx, or
- the control word in field bus systems

1.



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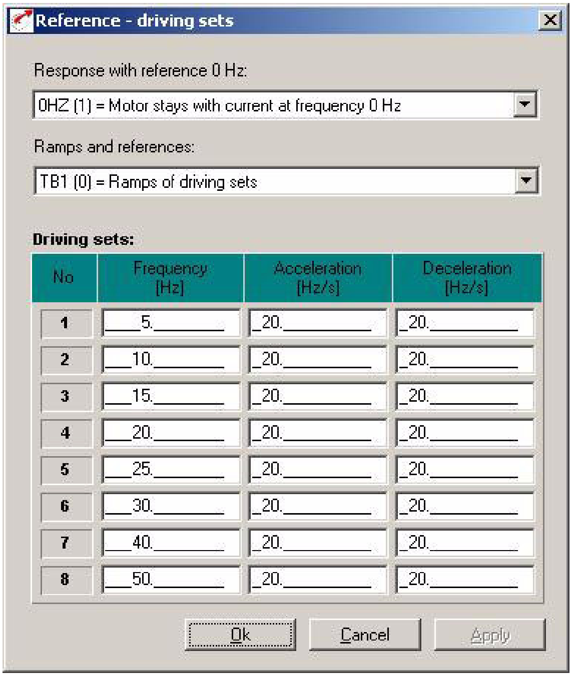


Figure 5.75 "Reference - driving sets" tab

Parameters of the driving sets

Parameter	Function	Value range	FS	Unit	Online
600-FFTB0	Table frequency 1	-1600 ... 1600	5	Hz	✔
601-FFTB1	Table frequency 2	-1600 ... 1600	10	Hz	✔
602-FFTB2	Table frequency 3	-1600 ... 1600	15	Hz	✔
603-FFTB3	Table frequency 4	-1600 ... 1600	20	Hz	✔
604-FFTB4	Table frequency 5	-1600 ... 1600	25	Hz	✔
605-FFTB5	Table frequency 6	-1600 ... 1600	30	Hz	✔
606-FFTB6	Table frequency 7	-1600 ... 1600	40	Hz	✔
607-FFTB7	Table frequency 8	-1600 ... 1600	50	Hz	✔
608-TACR0	Table acceleration ramp 1	0.01 ... 999	20	Hz/s	
609-TACR1	Table acceleration ramp 2	0.01 ... 999	20	Hz/s	
610-TACR2	Table acceleration ramp 3	0.01 ... 999	20	Hz/s	
611-TACR3	Table acceleration ramp 4	0.01 ... 999	20	Hz/s	

Table 5.91 Parameters from subject area _60TB Driving sets

Parameter	Function	Value range	FS	Unit	Online
612-TACR4	Table acceleration ramp 5	0.01 ... 999	20	Hz/s	
613-TACR5	Table acceleration ramp 6	0.01 ... 999	20	Hz/s	
614-TACR6	Table acceleration ramp 7	0.01 ... 999	20	Hz/s	
615-TACR7	Table acceleration ramp 8	0.01 ... 999	20	Hz/s	
616-TDCR0	Table deceleration ramp 1	0.01 ... 999	20	Hz/s	
617-TDCR1	Table deceleration ramp 2	0.01 ... 999	20	Hz/s	
618-TDCR2	Table deceleration ramp 3	0.01 ... 999	20	Hz/s	
619-TDCR3	Table deceleration ramp 4	0.01 ... 999	20	Hz/s	
620-TDCR4	Table deceleration ramp 5	0.01 ... 999	20	Hz/s	
621-TDCR5	Table deceleration ramp 6	0.01 ... 999	20	Hz/s	
622-TDCR6	Table deceleration ramp 7	0.01 ... 999	20	Hz/s	
623-TDCR7	Table deceleration ramp 8	0.01 ... 999	20	Hz/s	
624-TBSEL	Table driving set selector (display)	*			
298-RFMD	Ramp and reference selection	TB1 ... DP2	TB1		

Table 5.91 Parameters from subject area _60TB Driving sets

Settings for ramp selection of fixed frequencies

BUS	KP/DM	Function
0	TB1	Ramps of the driving set table
1	DP1	Ramps of the driving profile generator
2	TB2	Ramps and reference from driving set table and reference switchover RSSL1
3	DP2	Ramps of driving profile generator and reference from driving set table and reference switchover RSSL1

Table 5.92 Settings for 298-RFMD "Ramp and reference selection"

Explanatory notes

- Deactivation of parameter by the value 0 (zero)
- Parameter values which are produced from current calculations and so are not editable have an asterisk (*) in the "Value range" column.
- If one of the two ramps of a driving set becomes 0 Hz, the ramps of the driving set are deactivated. The other associated ramp is thus automatically set to 0 Hz.
- If one of the two ramps (acceleration ramp ACCRx, deceleration ramp DECRx) of a driving set is set to >0 Hz, and the second ramp still has the value 0 Hz, the second ramp is also automatically set to the value >0 Hz.
- The ramps of the driving profile generator are set in subject area "_59 DP-Driving profile generator".
- If the ramp selection is configured with reference switchover, instead of the current reference of reference channel RSSL1 on activation of a driving set 1...7 the reference selector RSSL1 is switched internally to the relevant driving set. The reference of the driving set 0 thus corresponds to the preset of the reference selector 280-RSSL1.
- The driving sets are selected with terminal selection via the digital inputs in function FFTB0 ... FFTB2. The function names represent only the significance of the driving set selection and not the direct selection of the table frequency with that parameter name.

  Example: ISD02 = FFTB0 ≙ Significance 2°
  ISD03 = FFTB1 ≙ Significance 2^1

5.5.6 _65CS-Characteristic data switchover (CDS)

Function	Effect
• Online switching is possible between two characteristic data sets	• Adaptation of the motor dynamics to the application • Operation of two different motors on one inverter module

Parameters for characteristic data set switchover

Parameter	Function	Value range	FS	Unit	Online
650-CDSAC	Characteristic data set (CDS) active	see Table 5.95	0		
651-CDSSL	Control location for switchover of characteristic data set (CDS)	see Table 5.96	OFF		✔
652-FLIM	Limit frequency for switchover to CDS	-1600 ... 1600	20	Hz	✔

Table 5.93 Parameters from subject area _65CS Characteristic data switchover

Explanatory notes

- Any application data set may contain a second characteristic data set.
- An overview of the functional areas containing parameters for the second characteristic data set is presented by Table 5.94.

Functional areas with characteristic data set parameters

Subject area	Parameter
Analog inputs	Scaling parameter
Clock input/clock output	Scaling parameter
Fixed frequencies	All parameters
Frequency limitation	All parameters
Reference structure	Min., max. and fixed frequency
Driving profile generator	Ramps
Current-controlled startup	All parameters
V/F characteristic	All parameters
IxR load compensation	All parameters
Slip compensation	All parameters
Current injection	All parameters

Table 5.94 Subject areas with parameters in the second characteristic data set (CDS)

Subject area	Parameter
Magnetization	All parameters
_78SS Speed controller SFC	All parameters
Current control	Reference current for control
Speed controller FOR	All parameters
Process controller	Controller parameters
Anti-oscillation	All parameters

Table 5.94 Subject areas with parameters in the second characteristic data set (CDS)

Active characteristic data set display 650-CDSAC

BUS	KP/DM	Function
0	CDS1	Characteristic data set 1 (CDS1) active
1	CDS2	Characteristic data set 2 (CDS2) active

Table 5.95 Display of active data set

Possibilities of characteristic data set switchover with 651-CDSSL

BUS	KP/DM	Function
0	OFF	No switchover • CDS 1 active
1	FILIM	Switchover on exceeding of frequency of value in parameter FILIM • CDS 2, if frequency > FLIM, otherwise CDS 1
2	TERM	Switchover via digital input • CDS 2, if IxDxx = 1, otherwise CDS 1
3	RED	Switchover on reversal of direction • CDS 2, if anti-clockwise, otherwise CDS 1
4	SIO	Switchover via SIO • CDS 2 if control bit set, otherwise CDS 1

Table 5.96 Settings for characteristic data set switchover variants

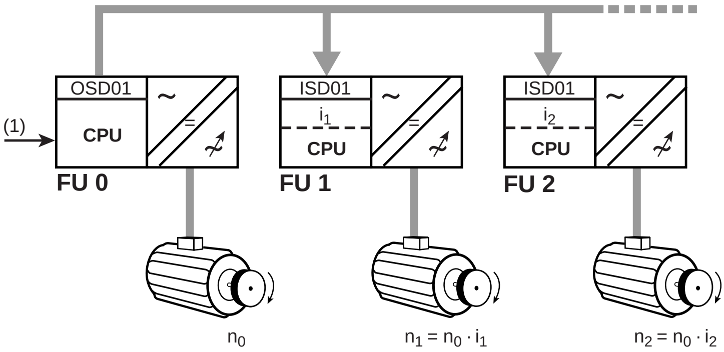
BUS	KP/DM	Function
5	OPTN1	Switchover via field bus at option slot 1 • CDS 2 if control bit set, otherwise CDS 1
6	OPTN2	Switchover via field bus at option slot 2 • CDS 2 if control bit set, otherwise CDS 1
7	FIABS	Switchover on exceeding of frequency of absolute value (amount formation) in parameter FILIM • CDS2, if frequency > (FILIM), otherwise CDS1

Table 5.96 Settings for characteristic data set switchover variants

5.5.7 _66MS-Master/ Slave operation

Function	Effect
• Speed synchronism of several different drives by setting of the coupling factor in Master/Slave operation	• Determine transmission ratio for reference coupling

One inverter module is parameterized as the master. The master passes the signal for fast reference coupling to up to five inverter modules parameterized as slaves.



(1) Reference
i_x Coupling factor of slave axle, parameter 837-MSFCT

Figure 5.76 Fast reference coupling via Master/Slave operation

Function	Parameter setting of the function selector	Terminal
Master	Digital output OSD01: FOS01 = FMSO	Signal: X2-16 Dig. ground: X2-17
Slave	Digital input ISD01: FIS01 = FMSI	Signal: X2-10 Dig. ground: X2-14

Table 5.97 Setting instructions

Reference coupling dependent on chosen operation mode

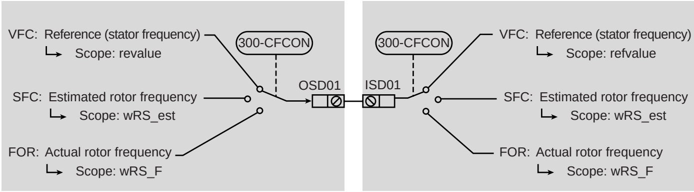
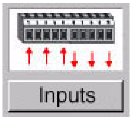


Figure 5.77 Reference coupling dependent on chosen operation mode on the master

1.



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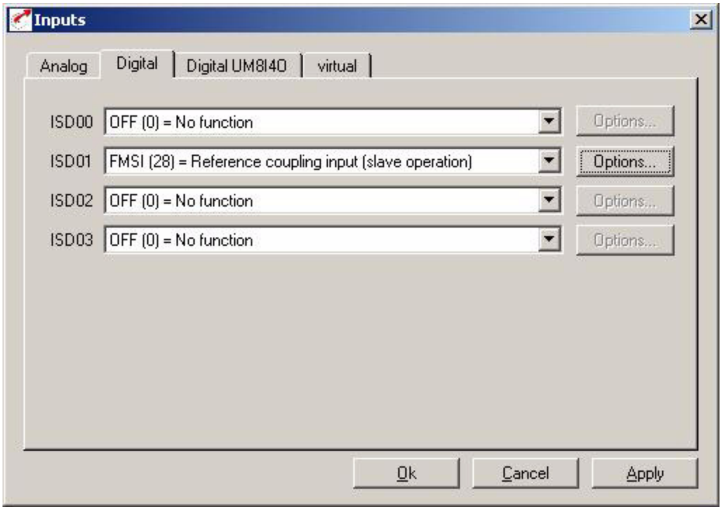


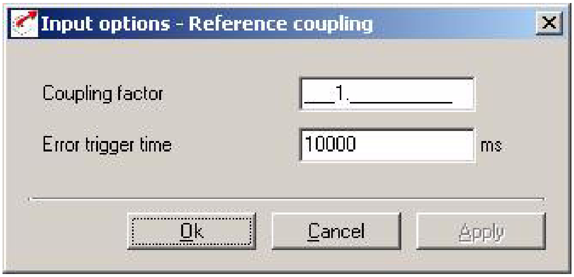


Figure 5.78 Master/Slave screens

Parameters for Master/Slave operation

Parameter	Function	Value range	FS	Unit	Online
837-MSFCT	Coupling factor for Master/Slave operation	0.0 ... 1000, 000000	1		✔
838-MSECT	Error trigger time in case of failure of reference master	0 ... 65535	0	ms	✔

Table 5.98 Parameters from subject area _66MS Master/Slave operation

Explanatory notes

- A maximum of six devices can be interlinked.
- In the event of failure of the reference input from the master, or if the reference signal checksum is faulty, the slave inverter responds after the set time in parameter 838-MSECT with error message E-FDG. The response to the error message can be configured in subject area "_51ER-Error messages".
- When the time period from 838-MSECT starts a warning message can be delivered. For this, the relevant function selector of the digital output must be set to the warning message WFDIG.
- Fast reference coupling is limited to output OSD01 and input ISD01.
- The coupling factor MSFCT is represented in INT 32Q16 number format.
  That means that the decimal places are represented at a pitch of 65536.

Example of coupling factor MSFCT

Input of coupling factor in parameter 837-MSFCT

Given:i = 2.032 → 837-MSFCT=2.032
Set: Executed value of coupling factor with internal processing of processor

Solution:

1. 2.032 x 65536 = 133169.152
2. Eliminate decimal places: 133169
3. 133169 : 65536 = 2.0319

Attention! Digital output OSD01 has no function in the slave inverter module, and cannot be used as the master for other slaves.

Structure of reference processing in the slave

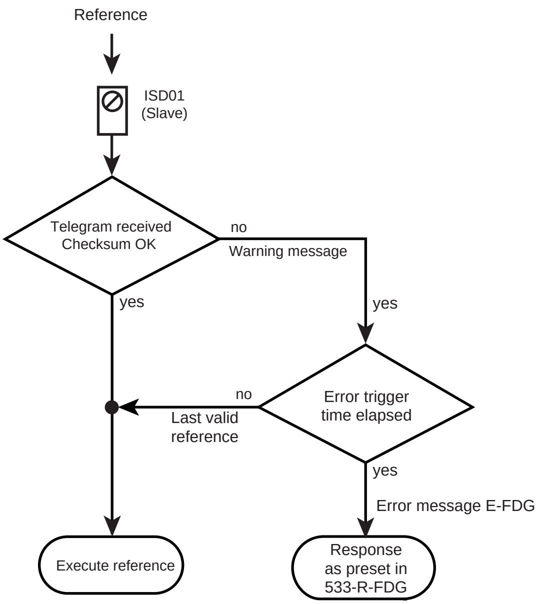
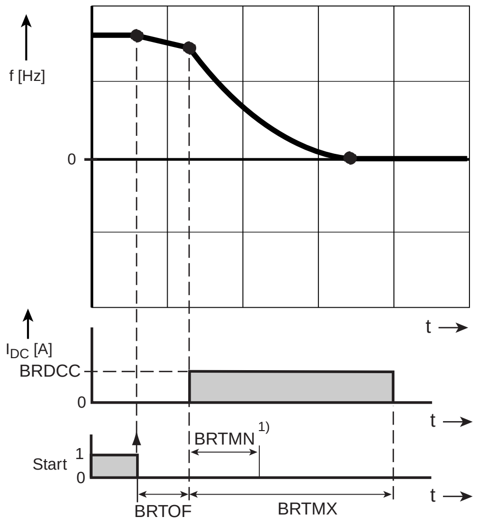


Figure 5.79 Structure of reference processing in the slave

If no telegram with a correct checksum is received within the error trigger time error message E-FDG is triggered when the time has elapsed. During the error trigger time the last valid reference is executed.

5.5.8 _67BR-DC braking

Function	Effect
• Feed of a direct current into the motor, causing it to brake.	• No braking resistor is required to brake motors.



1) No start possible within this time span

I_{DC} = equalizing current of CDA3000

Figure 5.80 DC braking with demagnetization time BRTOF and braking time BRTMX

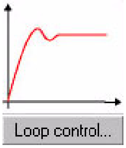
For demagnetization purposes no current is applied to the motor in the time BRTOF, so the field in the motor can be safely removed. Then for the time BRTMX the direct current BRDCC is injected into the motor and the motor is braked without energy feedback into the inverter module. The motor converts the braking energy directly into heat.

Note: If too short a demagnetization time is chosen, the residual magnetization of the motor may result in error shutdowns in the inverter module.

Application with differing motor types:

- Asynchronous motor: ✔ — Braking time longer than braking with stop ramp, but no braking resistor necessary for inverter module.
- Synchronous motor, reluctance motor: ⊘ — No braking effect, because at high speeds the sum total of the braking torques per revolution is virtually zero (due to the rotor design). The resulting regenerative operation may lead to error messages.

1.



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3.

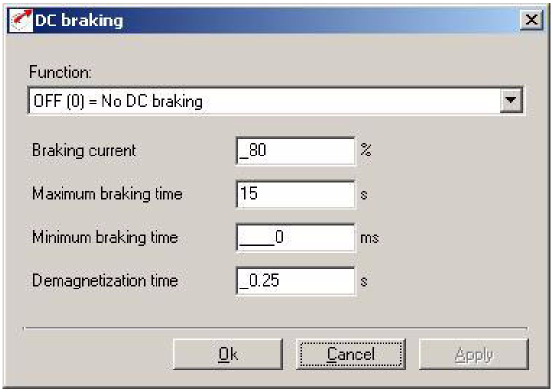


Figure 5.81 "DC braking" tab

Parameters for DC braking

Parameter	Function	Value range	FS	Unit	Online
670-BRDC	Mode of actuation of DC braking	OFF ... STOP	OFF		✔
671-BRDCC	Braking current for DC braking referred to device rated current	0 ... 180	80	%	
672-BRTMX	Maximum braking time	0 ... 60	15	s	✔
673-BRTOF	Demagnetization time before DC braking	0.10 ... 10.00	2	s	✔
674-BRTMN	Minimum braking time	0 ... 65535	0	ms	✔

Table 5.99 Parameters from subject area _67BR DC braking

Explanatory notes

- Depending on parameter setting, the motor may either run down uncontrolled, or be decelerated with a stop ramp or with direct current.
- After DC braking, the DC holding function can be appended to counteract any rotation caused by the load on the motor.
- The braking torque is reduced to approx. one third of the braking torque in operation with a braking resistor (braking chopper operation).
- The minimum braking time (674-BRTMN) cannot be aborted by a new start signal.
- In the time between the minimum braking time (674-BRTMN) and the maximum braking time (672-BRTMX) the DC braking can be aborted by a start signal.
- The maximum braking time period (672-BRTMX) includes the minimum braking time (674-BRTMN).
- In DC braking the BRK2 motor holding brake function has no effect.

Attention! By activating the DC brake, in response to STR/STL=0 (Low) DC braking is executed instead of the stop ramp (STPRx).

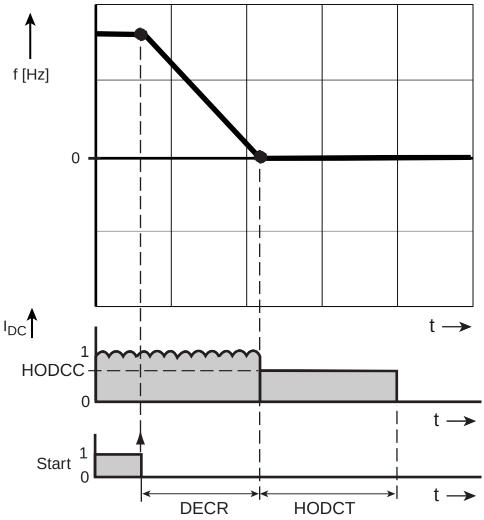
Settings of the DC braking activation mode with 670-BRDC

BUS	KP/DM	Function
0	OFF	No DC braking
1	NSTRT	DC braking active after cancellation of starting
2	STOP	Selection of DC braking via digital input or SOI control bit (field bus system) Digital input: FIxxx = /STOP

Table 5.100 Settings for 670-BRDC DC braking

5.5.9 _68HO-DC holding

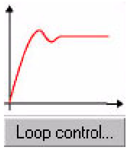
Function	Effect
• On completion of DC braking an adjustable direct current is injected into the motor.	• Rotation of the motor shaft under no load is counteracted. No standstill torque is applied against a load on the motor shaft.



I_E Output current of CDA3000
DECR Controlled braking (DECRx, STPRx, BRDC)

Figure 5.82 DC holding for the time HODCT

1.



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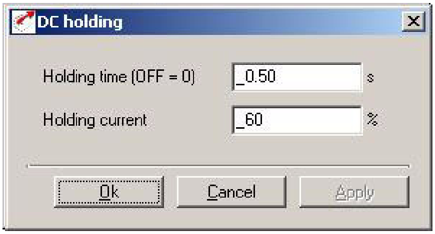


Figure 5.83 "DC holding" tab

Parameters for DC holding

Parameter	Function	Value range	FS	Unit	Online
680-HODCC	Holding current referred to device rated current	0 ... 180	60	%	
681-HODCT	Holding time in DC holding	0.00 ... 60.00	0.5	s	✔

Table 5.101 Parameters from subject area _68HO DC holding

Explanatory notes

- Deactivation of DC holding by HODCT = 0 s.

Activation of DC holding with 68-HODCT ≠ 0 s

Preceding function	Activation condition, DC holding
DC braking 670-BRDC = ON	At end of maximum braking time 672-BRTMX
Stop ramp STPRx	On reaching of reference zero.
Braking ramp DECRx	

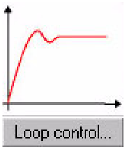
Table 5.102 Activation conditions for DC holding

5.5.10 _80CC-Current controller

Function	Effect
• Setting of the PI controller for current control	Parameter setting of the PI current controllers for the functions • DC braking • DC holding • Magnetization (VFC) • Current injection (VFC) • Torque-forming current i_q in SFC • Flux and torque-forming current in FOR

Note: Activation of auto-tuning of the motor and controller parameters by way of parameter 161-ENSC = START in subject area "_15FC-Initial commissioning" (section 5.1) automatically optimizes the current controller setting.

1.



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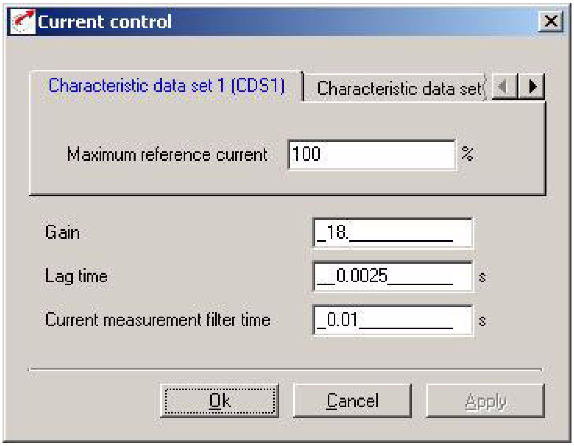


Figure 5.84 "Current controller" screen

Parameters of the current controller

Parameter	Function	Value range	FS	Unit	Online
800-CCG	Current controller gain	0 ... 500	dependent on inverter		
801-CCTLG	Current controller lag time	0.001 ... 100	dependent on inverter	s	
802-CCTF	Filter time constant for current measurement in SFC	0.0005 ... 20	dependent on inverter	s	
803-VCSFC	Correction of fault voltage characteristic (SFC, FOR)	0 ... 199	dependent on inverter	%	✔
804-CLIM1	CDS1: Maximum reference current for current control	0 ... 180	100	%	
805-CLIM2	CDS2: Maximum reference current for current control	0 ... 180	100	%	

Table 5.103 Parameters from subject area _80CC Current controller

Explanatory notes

- The filter time constant for current measurement is used only by the Sensorless Flux Control (SFC) mode.
- The following functions are operated with the parameters determined by auto-tuning:
  - DC braking
  - DC holding
  - Magnetization (VFC)
  - Current injection (VFC)
  - Torque-forming current i_q in SFC
  - Flux and torque-forming current in FOR
- The factory setting of the current controller relates to an IEC standard motor with the respective device power rating. You will find the motor specification in subject area "_15FC-Initial commissioning" (section).
- With the analog input ISA01 by way of FISA1=SCALE the current can be influenced for torque formation within CLIMx. A torque limitation can thus be effected by way of the analog input.

Notes on optimization

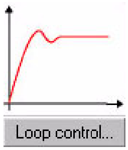
Open-loop/ closed-loop control mode	Need for optimization
VFC	Motor power output = inverter output and IEC standard motor • No optimization required, because 1:1 rating in factory setting Motor output power < inverter output or no IEC standard motor • Optimization and adaptation by activation of auto-tuning (see section 5.1 "_15FC-Initial commissioning")
SFC	Optimized after successful initial commissioning with auto-tuning (see section 5.1 "_15FC-Initial commissioning"). Further information: For required setting aids refer to section 6.2.3 "Tips and optimization aids for control engineers".
FOR	Optimized after successful initial commissioning with auto-tuning (see section 5.1 "_15FC-Initial commissioning").

Table 5.104 Notes on optimization

5.5.11 _64CA-Current-controlled startup

Function	Effect
• The drive accelerates with the preset acceleration ramp. When a programmable current limit is reached the acceleration is slowed or stopped, depending on selected function, until sufficient current reserves are available again. • The same applies to deceleration of the drive.	• Protection against current overload shut-off in acceleration of large moments of inertia. • Protection against drive stalling. • Acceleration and deceleration processes with maximum dynamics along the current limit.

1.



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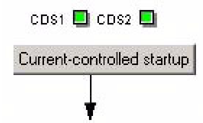


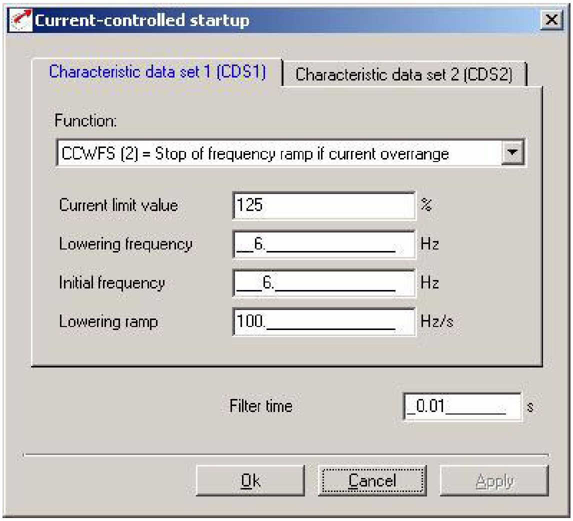


Figure 5.85 "Current-controlled startup" tab

Parameters of current-controlled startup/rundown

Parameter	Function	Value range	FS	Unit	Online
639-CLTF	Filter time constant for current-controlled startup/rundown	0.002 ... 20	0.01	s	
640-CLSL1	CDS1: Function selector	OFF, CCWFS, CCWFR	CCWFS		✔
641-CLCL1	CDS1: Current limit value	0 ... 200	125%	%	
642-CLFL1	CDS1: Lowering frequency	0 ... 100	4	Hz	
643-CLFR1	CDS1: Initial frequency	0 ... 1600	0	Hz	
644-CLRR1	CDS1: Lowering ramp	0 ... 1600	100	Hz	
645-CLSL2	CDS2: Function selector	OFF, CCWFS, CCWFR	CCWFS		✔
646-CLCL2	CDS2: Current limit value	0 ... 200	125%	%	
647-CLFL2	CDS2: Lowering frequency	0 ... 100	4	Hz	
648-CLFR2	CDS2: Initial frequency	0 ... 1600	0	Hz	
649-CLRR2	CDS2: Lowering ramp	0 ... 1600	100	Hz	

Table 5.105 Parameters of subject area _64CA Current-controlled startup

Note: When setting the parameter values manually in VFC mode, please pay attention to the information set out in section 6.1.7 "Tips and optimization aids for control engineers" (step 3), otherwise the "current-controlled startup" function may negatively affect the "current injection" function.

Settings of the function selector CLSLx for current-controlled startup/rundown

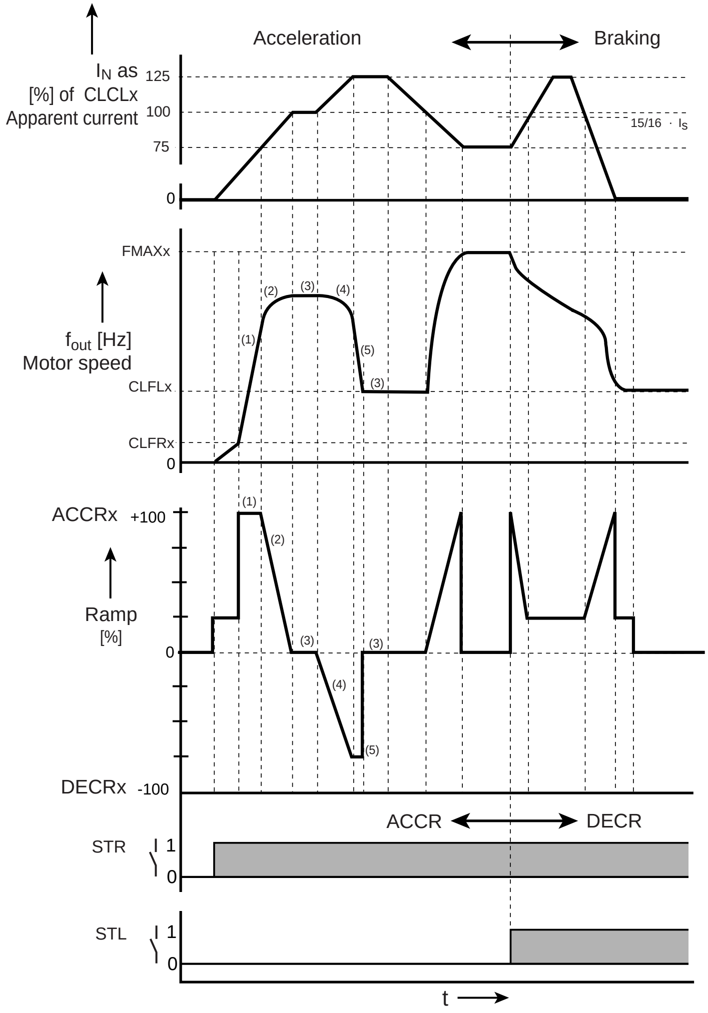
BUS	KP/DM	Function
0	OFF	Current-controlled startup inactive.
1	CCWFR	During acceleration with the acceleration ramp ACCRx (1), when 75% of the current limit value CLCLx (2) is reached the acceleration is reduced in linear mode from 100% ACCRx at the current limit 75% CLCLx to 0% ACCRx at 100% CLCLx. This means that at 100% CLCLx the drive is no longer being accelerated (3). If the current limit 100% CLCLx is exceeded (4), the reference frequency is reduced. The reduction is effected with the steepness specified in CLRRx. The steepness rises in linear mode up to 100% CLRRx at the current limit 125% CLCLx. This process is limited when the lowering frequency CLFLx is reached (5). When the apparent current falls below the current limit 100% CLCLx the drive is again accelerated with the acceleration ramp ACCRx. The conditions previously detailed apply once again. The same also applies to braking, where the frequency can be increased up to the maximum.
2	CCWFS	Function as in the case of CLSLx = 1, but the output frequency is stopped at 125% CLCLx. That is to say, there is no acceleration or frequency reduction.
	( )	For presentations of the operational phases, see Figure 5.86 and Figure 5.87.

Table 5.106 Settings for function selector for current-controlled startup/ rundown

Explanatory notes

- The function implements a current limitation by altering the startup/ rundown ramps.
- In the frequency range 0 Hz to the initial frequency CLFRx the current acceleration ramp ACCRx is reduced to 25%.
- The control remains active after startup. In this way, under increasing load - and thus increasing current - the speed is reduced under ramp control, in order to protect the motor against stalling. The same also applies to braking, where the frequency can be increased up to the maximum.
- The current limit value CLCLx relates to the device rated current. The rated current of the respective inverter module is designated as CLCLx = 100%.

Example: Acceleration and braking in motorized operation with CLSLx = CCWFR



I_N Rated device current as apparent current I_S
f_{out} Motor speed
CLFLxLowering frequency
CLFRxInitial frequency
(1) to (5) see Figure 5.87 and Table 5.106

Figure 5.86 Acceleration and braking in motorized operation CLSLx = CCWFR

Notes for control engineers:

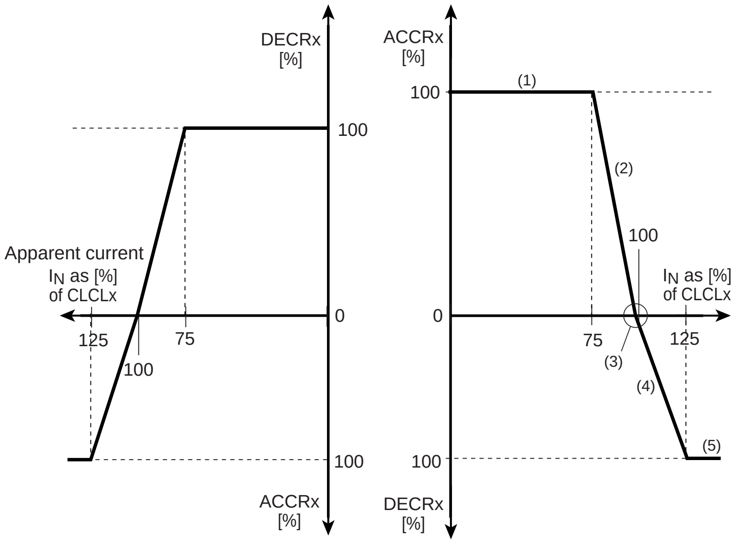
f_{out} < CLFRx (initial frequency)

If the actual speed of the motor is below the initial frequency CLFRx, the preset ramp steepness ACCRx/DECRx is limited to a quarter.

$f_{out} \geq$ CLFRx (initial frequency)

Operating state / Load	Function
• Braking, regenerative • Acceleration, motorized • Stationary, motorized	see Figure 5.87
• Braking, motorized • Acceleration, regenerative	see Figure 5.86

Table 5.107 Modes of action of current-controlled startup/rundown



(x) Presentation of operational phases (1) to (5) in Table 5.106 and Figure 5.86

Figure 5.87 Dependency of the ramp steepness on the rated device current dimensioned to the current limit value

Attention! In lifting applications this function should be disabled, because regenerative lowering loads during braking may cause the drive to accelerate as a result of the prevailing apparent current I_S.

5.5.12 _69PM-Modulation

Function	Effect
• Setting of switching frequency of inverter power stage	The higher the switching frequency, • the lower the noise, • the smoother the motor runs at high speed and • the lower the output power of the inverter module.

As the switching frequency (modulation frequency) increases the power loss of the inverter module also increases. The reason for this lies in the common losses in the switching of power semiconductors in the power stage. This necessitates a reduction in the power of the inverter module in order to prevent the device from overheating. The power rating is also influenced by the motor cable length, the ambient temperature and the mounting height.

Minimum switching frequency of power stage for very smooth running of the motor

Switching frequency of power stage	Max. output frequency of inverter
4 kHz	to 400 Hz
8 kHz	to 800 Hz
16 kHz	to 1600 Hz

Table 5.108 Minimum switching frequency for adequately smooth running of the motor

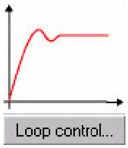
Note that as from firmware version V3.2 the maximum permissible rotating field frequencies are limited - see following table:

Inverter type	Size	Rated current	Rotating field frequency
CDA32.004 to CDA34.032	(BG1...5)	4 to 32 A	0 ... 400 Hz max.
CDA43.045 to CDA34.170	(BG6...8)	45 to 170 A	0 ... 200 Hz max.

Note: To use inverters with rotating field frequencies > 200/400 Hz you will need the special **inverter version for high-frequency motors**. For detailed ordering information refer to the CDA3000 Order Catalogue.

Rule of thumb: The modulation frequency should be 8 to 10 times the maximum output frequency of the inverter.

1.



2.

3.

Figure 5.88 Switching frequency of power stage

Parameters of the modulation frequency

Parameter	Function	Value range	FS	Unit	Online
690-PMFS	Switching frequency of power stage	4, 8, 16	dependent on device	kHz	

Table 5.109 Parameters from subject area _69PM Modulation

Explanatory notes

- Factory setting of devices < 22 kW: 8 kHz, max. 400 Hz
  Factory setting of devices > 22 kW: 4 kHz, max. 200 Hz
- Safety functions for the device are automatically adapted to the modulation frequency.
- Devices with outputs of 22 kW and above cannot be operated at 16 kHz.

Maximum permissible current dependent on switching frequency of power stage see section 5.3.3 "Device protection".

Current losses on motor cables

Clock frequency	Mains voltage 1 x 230 V		Mains voltage 1 x 400 V		Mains voltage 1 x 460 V	
	Motor choke		Motor choke		Motor choke	
	without [mA per m]	with [mA per m]	without [mA per m]	with [mA per m]	without [mA per m]	with [mA per m]
4	10	Not available at time of going to press	15	Not available at time of going to press	20	Not available at time of going to press
8	15		30		40	
16	25		60		70	

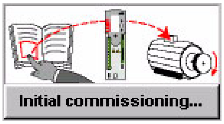
Table 5.110 Current losses on motor cable dependent on clock frequency

Allow for current losses with cable lengths >10 m or 25 m.
Table 5.110 applies to motor cable lengths up to 150 meters.

5.5.13 _84MD-Motor data

Function	Effect
• Filing of acquired motor data for further calculation	• The motor data can be transferred to other inverter modules • In systems with identical motors no motor identification is required as the parameters can be transferred

1.



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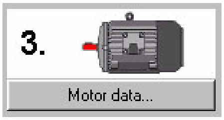


Motor data acquired during auto-tuning

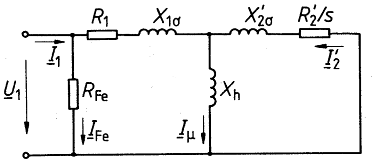
Parameter	Function	Value range	FS	Unit	Online
454-MOLMF	Correction factor, magnetizing inductance (Lh characteristic)	0...999.95	100	%	
839-MONAM	Name of motor	0 ... 28 characters			
840-MOFNM	Nominal pole flux	0 ... 100	*	Vs	
841-MOL_S	Leakage inductance	0 ... 10	*	H	
842-MOR_S	Stator resistance	0 ... 128	*	W	
843-MOR_R	Rotor resistance	0 ... 500	*	W	
844-MONPP	Number of pole pairs of motor	0 ... 32	*		
850-MOL_M	Magnetizing inductance of motor from magnetic characteristic	0 ... 10	*	H	

Table 5.111 Parameters of subject area _84MD Motor data

Explanatory notes

- The fields marked with an asterisk (*) are dependent on the rated power of the inverter module.
- In the factory setting the typical data of an IEC asynchronous standard motor of the device rated power are entered in the parameters.
- During auto-tuning of the inverter module (163 -ENSC=START) the motor data are acquired in the course of initial commissioning. The precondition for this is correct input of the motor rating plate data and a closed motor circuit.
- All motor data can be transferred and saved by way of the SMARTCARD or the DRIVEMANAGER. The parameters of the current and speed control loops should additionally be transferred so that the motor can be run correctly on the inverter module.
- In identification of special motors and main spindle motors >20 KW, incorrect plotting of the Lh characteristic may occur in isolated cases. In most cases the error is indicated by the fact that the desired rated speed of the drive is not reached.
  Remedy: Increase parameter MOLMF until the motor is running about 5% above rated speed.

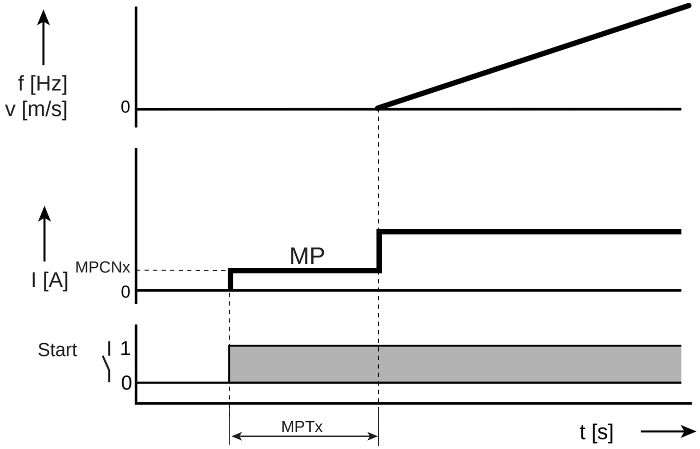
Simplified equivalent circuit diagram of the asynchronous machine



s	Slip
X_h	Magnetizing inductance
R_1	Stator phase resistance
R_2	Rotor resistance
$X_{1\sigma}$	Stator magnetizing inductance
$X_{2\sigma}$	Rotor magnetizing inductance
R_{FE}	Iron loss resistance
I_M	Magnetizing current

5.5.14_77MP-Remagnetization

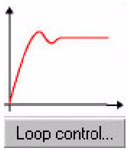
Function	Effect
• Injection of a defined direct current via a PR current control circuit into the motor	• Increase starting and standstill torque • Deactivation of Voltage Frequency Control mode during the magnetization and flux build-up phase



MPCNx Magnetizing current
MPTx Magnetizing time

Figure 5.89 Magnetization phase (MP)

1.



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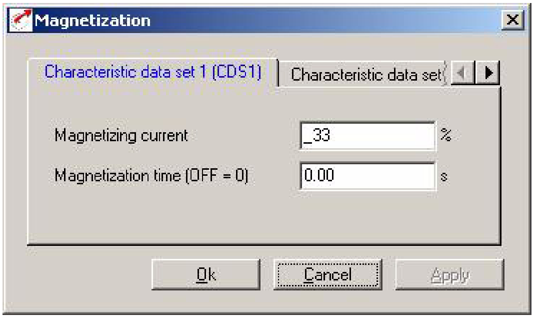


Figure 5.90 "Magnetization" tab

Parameters of magnetization

Parameter	Function	Value range	FS	Unit	Online
770-MPCN1	CDS1: Magnetizing current	0 ... 180	33	%	
771-MPT1	CDS1: Magnetization time VFC	0.00 ... 2.00	0.00	s	
772-MPCN2	CDS2: Magnetizing current	0 ... 180	33	%	
773-MPT2	CDS2: Magnetization time VFC	0.00 ... 2.00	0.00	s	
774-MPT	Magnetization time for SFC and FOR (calculated during auto-tuning)	0.00 ... 16.00	0.50	s	

Table 5.112 Parameters from subject area _77MP Magnetization

Explanatory notes

- When the time MPTx elapses the inverter module switches to the "Open-loop control/Closed-loop control active" state. That means that during the magnetization phase the V/F characteristic is deactivated for a short time.
- The transition can be made directly from the magnetization phase to current injection.
- The magnetization time for control modes SFC and FOR is calculated during auto-tuning (163-ENSC) and should only be altered by highly experienced control engineers.

5.5.15 _86SY-System

Function	Effect
• Performing a device reset • Triggering of a controller reinitialization	• The device is optionally reset completely or in part to its factory setting (FS) • Controller data and limit values are recalculated

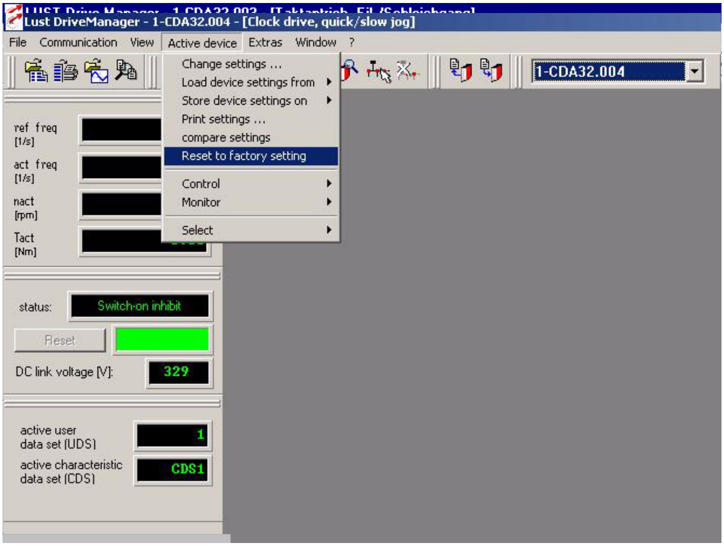


Figure 5.91 Reset to factory setting

Parameters of the system

Parameter	Function	Value range	FS	Unit	Online
4-PROG	Reset device to factory setting	0 ... 65535	2		✔
15-PLRDY	Activate control initialization	ON/OFF	OFF		✔

Table 5.113 Parameters from subject area _86SY-System

Explanatory notes

- In the factory setting the application data set DRV_1 is activated (see parameter list in Appendix).
- A control initialization is always carried out under the following conditions:
  - Setting of ENPO signal and startup (STR or STL)

  In KP200 operation:
  - Quitting of the subject area level in the PARA menu branch, into the menu branch selection level (menu level). The display shows "MENU".
- Activation of a control initialization by means of parameter 15-PLRDY is only necessary when the DRIVEMANAGER device status indicator shows "Parameter setting" and the device is to adopt the newly set values of parameters for control of the device in advance. After the control initialization the device status is set to switch-on inhibited/ready.
- Not every parameter setting leads to the "Parameter setting" device state.

Reset device to factory setting 4-PROG

BUS	KP/DM	Function
1	1	Reset the active data set in the RAM to its factory setting. The factory setting must then be saved to a user data set, because the RAM is a volatile storage medium.
815	815	Reset the active data set in the RAM and all user data sets **up to user level 4** to factory settings. In the final step, the factory setting is saved to all user data sets.
850	850	Reset the active data set in the RAM and all user data sets **up to user level 6** to factory settings. In the final step, the factory setting is saved to all user data sets.

Table 5.114 Factory setting reset functions

5.5.16 _82PR-Process controller

Function	Effect
• Actual value input via analog input ISA00 • Freely selectable reference input • Monitoring of max. control deviation • Switch to fixed frequency	• Control of dynamic processes • Night lowering for minimum operation • Setting of control via DRIVEMANAGER scope

Attention! When using a firmware version ≥V3.3 in the ROT_5 function, after loading any parameter data set based on a firmware version < V3.3 the process controller must be deactivated (see section 5.5.16 "_82PR-Process controller"). The process controller is not deactivated automatically in this case.

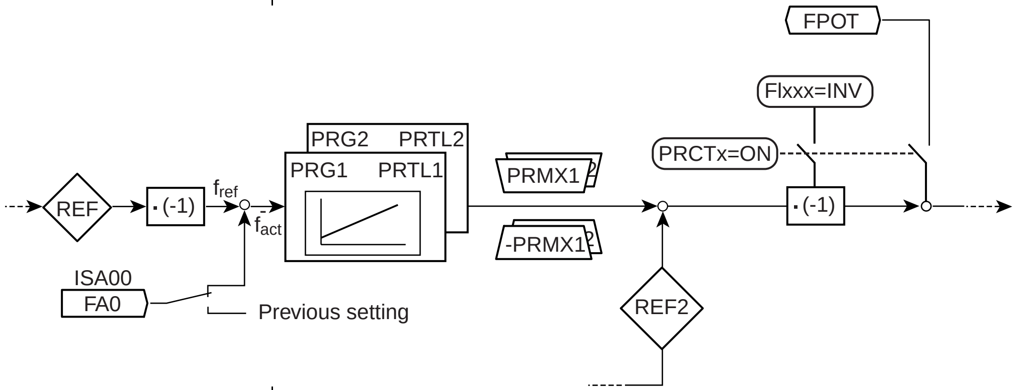
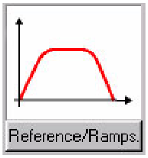


Figure 5.92 Block diagram of process controller with integration into reference structure

1.



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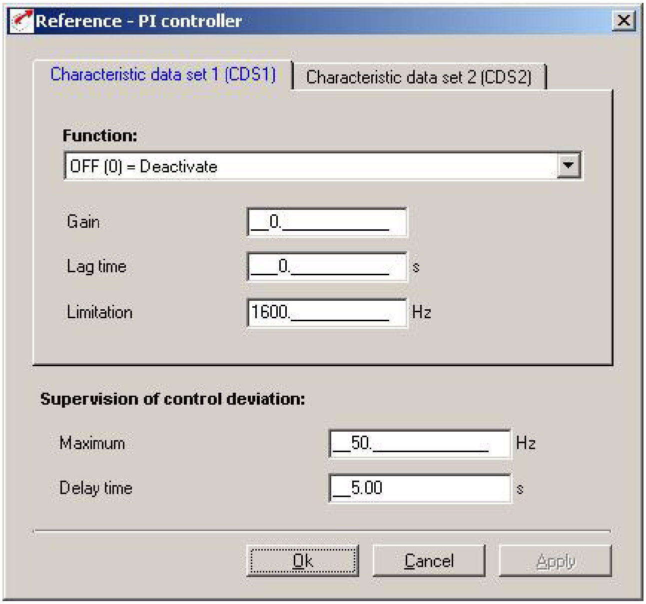


Figure 5.93 Process controllers

Parameter	Function	Value range	FS	Unit	Online
820-PRCT1	CDS1: Process controller On/Off	ON_1/ON_2/OFF	OFF		✔
821-PRVT2	CDS2: Process controller On/Off	ON_1/ON_2/OFF	OFF		✔
822-PRG1	CDS1: Process controller gain	0 ... 250	0.10		✔
823-PRTL1	CDS1: Process controller lag time	0 ... 9999	0.10	s	✔
824-PRG2	CDS2: Process controller gain	0 ... 250	0.10		✔
825-PRTL2	CDS2: Process controller lag time	0 ... 9999	0.10	s	✔
826-PRMX1	CDS1: Process controller limitation	0 ... 1600	1600	Hz	
827-PRMX2	CDS2: Process controller limitation	0 ... 1600	1600	Hz	
828-PRMCD	Maximum control deviation of process controller	0 ... 1600	50	Hz	
829-PRACD	Switch-on delay of process controller max. control deviation function	0 ... 999	5	s	

Table 5.115 Parameters from subject area _82PR-Process controller

Explanatory notes

- The MOP function is disabled when the process controller is activated.
- The reverse direction function in the reference structure as from reference point 3 (REF3) is disabled on activation of the process controller. The reverse direction function inverts the reference value of the process controller.
- The output of the process controller is limited to +/-PRMXx. When the limit is reached the integrating component of the controller is stopped and released again when the value falls back within the limit (see Table 5.117 "Limitation of process controller I-component on exceeding of a reference limit")
- The sampling time of the process controller is 2 ms.
- On activation of the stop ramp STPRx monitoring of the maximum control deviation is reset. This prevents an "exceeding of maximum control deviation" error message. In the event of a reference change via the deceleration or acceleration ramp the monitor remains active.
- The control deviation can be monitored for exceeding of the maximum value 828-PRMCD. When loop control is started the monitor is activated after the time 829-PRACD.
  Exceeding of the maximum control deviation triggers the error message E-PRC. The response to this error message can be configured in parameter 535-R-PRC "Response to exceeding of max. control deviation (PR)" (see section 5.3.10 "_51ER-Error messages").

- When the process controller is activated parameter 597-RF0 is automatically set to 0 Hz. So current is still applied to the motor at the reference value 0 Hz.

Setting for parameters 820-PRCT1 and 821-PRCT2

BUS	KP/DM	Function	Effect
0	OFF	Controller inactive	Process controller off
1	ON_1	Controller active, mode 1	When the controller is activated it starts up with the value 0 for the manipulated variable
2	ON_2	Controller active, mode 2	Apply current manipulated variable after activation of controller by reference (manipulated variable) RE.F6 (output of ramp generator)

Table 5.116 Setting for parameters 820-PRCT1 and 821-PRCT2

Limitation of process controller I-component

Reference limitation / Response Controller I-component	Case I	Case II		Case III
	Process controller limitation PRMXx reached	Max. frequency limit FMAXx reached	Min. frequency limit FMINx $\neq$ 0 reached	Min. frequency limit FMINx +0 reached and directional lock active
I-component is stopped	✔			
I-component is set to a value resulting from P-component and limitation		✔		✔
No I-component limitation			✔	

Table 5.117 Limitation of process controller I-component on exceeding of a reference limit

Explanatory notes

- The process controller can be set with the aid of the DRIVEMANAGER scope function. The controller parameters can be preset according to the Ziegler and Nichols or Chien, Hrones and Reswik setup criteria.
- If a reference limit of the controller I-component is exceeded, the I-component procedure is as shown in the following table.

Setting of process controller

Presentation of a control circuit comprising a controlled system (here: PT_1 system) and a PR controller

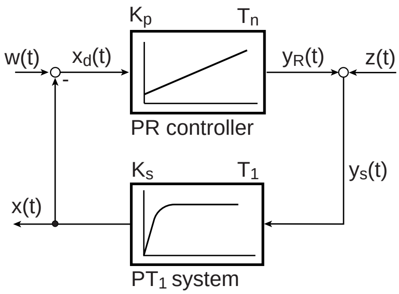


Figure 5.94 Presentation of a control circuit

Formula symbol	Designation	Digital scope	
		Recording variable	Abbrevi
$w(t)$	Reference input variable	Process controller: Reference value	piRegRef
$x_d(t)$	Control difference/control deviation	Process controller: Control deviation	piRegE
$x_{(t)}$	Controlled variable	Process controller: Actual value	piRegIn
$y_R(t)$	Controlled variable controller output	Process controller: Output value	piRegOut
$y_s(t)$	Manipulated variable controlled system input	-	-
$z(t)$	Disturbance	-	-

Table 5.118 Assignment of the control circuit variables to the DRIVEMANAGERdigital scope

Generally a controller is set better the shorter the correction time, the lower the overshoot (Ü) of the controlled variable and the smaller the residual control deviation ($x_d(t)$).

This is demonstrated by the characteristic of the controlled variable based on the control deviation $x_d(t)$.

Unstable characteristic

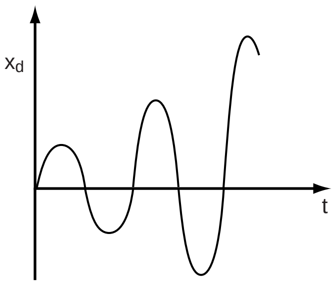


Figure 5.95 Unstable control characteristic

Stability limit

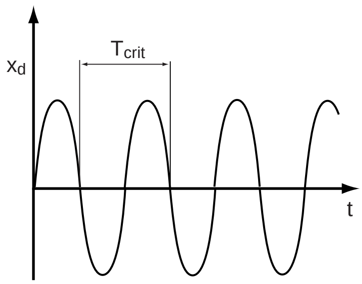


Figure 5.96 Control characteristic at stability limit

Damped oscillation

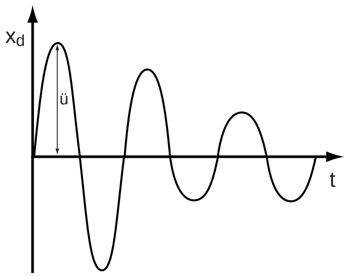


Figure 5.97 Control characteristic with damped oscillation

Aperiodic damping

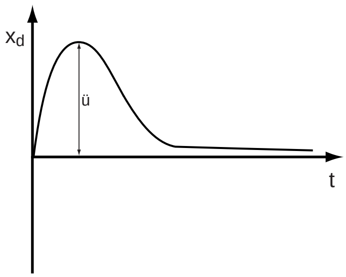


Figure 5.98 Control characteristic with aperiodic damping

In practice, the following settings have proved successful:

- Ziegler and Nichols settings
- Chien, Hrones and Reswik settings

Ziegler and Nichols settings

Note: With this method the control circuit is operated at the stability limit. If this is not possible for operational or safety reasons, this optimization method must not be used.

This method requires no data from the controlled system. You will need the DRIVEMANAGER scope function.

Procedure:

1. Start the DRIVEMANAGER digital scope. Record the following values:
   Channel 0: Start control, e.g. input ISD00=STR
   Channel 1: Process controller output value (piRegOut)
   Channel 2: Process controller reference value (piRegRef)
   Channel 3: Process controller actual value (piRegIn)
   Trigger: Channel 0, trigger level: 0.5

2. Set lag time PRTLx = 0 seconds, thereby operating the process controller as a purely P-controller

3. Increase the controller gain PRGx step-by-step until the controlled variable "Process controller: output value" just begins executing a continuous oscillation at constant amplitude. The controller gain PRGx preset for this is noted as critical controller gain $PRGx_{crit}$.

4. The critical period T_{crit} of the control oscillation is obtained from the digital scope.

5. The control parameters PRGx and PRTLx are calculated on the basis of the following table and then set.

Controller type	Controller gain PRGx	Lag time PRTLx
P-controller	0.5 x $PRGx_{knit}$	-
PR controller	0.45 x $PRGx_{knit}$	0.83 x T_{knit}

Table 5.119 Ziegler and Nichols settings

6.

6. The parameter settings obtained should be checked and must be fine-tuned as necessary for further optimization.

Chien, Hrones and Reswik settings

In this method, the transfer coefficient K_s, the compensating time T_g and the delay time T_u of the controlled system must be known. With the aid of the DRIVEMANAGER digital scope these variables can be determined graphically by recording the step response. This method is particularly suitable for higher-order controlled systems.

1.

1. Start the DRIVEMANAGER digital scope. Record the following values:

Channel 0: Start control, e.g. input ISD00=STR

Channel 1: Process controller output value (piRegOut)

Channel 2: Process controller reference value (piRegRef)

Channel 3: Process controller actual value (piRegIn)

Trigger: Channel 0, trigger level: 0.5

2.

2. Calculation of K_s:

$$K_S = \frac{\text{Actual value change}}{\text{Manipulated variable change}} = \frac{\Delta X}{\Delta y_R} = \frac{x_1 - x_0}{y_1 - y_0}$$

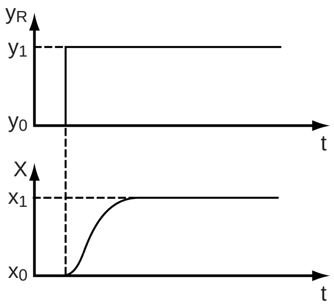


Figure 5.99 Step response of a higher-order controlled system

3.

3. Definition of T_u and T_g:

For this the inflectional tangent through the step response needs to be plotted. The point of intersection through the time axis defines the delay time T_u. The point of intersection of the compensated step response with the inflectional tangent defines the compensating time T_g.

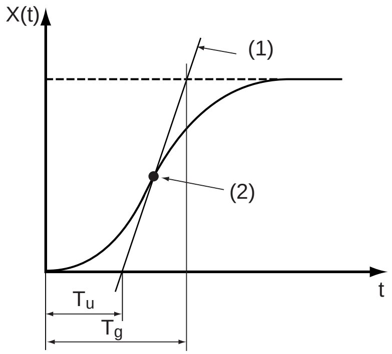


Figure 5.100 Graphical definition of delay and compensating times

Note: In controlled systems with dead time T_t in place of the delay time T_u the substitute dead time from $T_u + T_t$ must be taken into account.

4.

4. The control parameters PRGx and PRTLx are calculated on the basis of the following table and then set.

Controller	Aperiodic characteristic		Control characteristic with 20%	
	PRGx	PRTLx	PRGx	PRTLX
P-controller	$\approx \frac{0.3}{K_S} \cdot \frac{T_g}{T_u}$	-	$\approx \frac{0.3}{K_S} \cdot \frac{T_g}{T_u}$	-
PI controller	$\approx \frac{0.6}{K_S} \cdot \frac{T_g}{T_u}$	$\approx 4 \cdot T_u$	$\approx \frac{0.3}{K_S} \cdot \frac{T_g}{T_u}$	$\approx 2.3 \cdot T_u$

Table 5.120 Chien, Hrones and Reswik setting rules for fast disturbance compensation

5.

5. The parameter settings obtained should be checked and must be fine-tuned as necessary for further optimization.

6 Control modes

During commissioning of the inverter module three different control methods can be selected. The necessary identification of the motor is carried out automatically by the CDA3000 inverter module, causing all control circuits to be preset.

Overview of motor control methods

Voltage Frequency Control (VFC):

- Asynchronous motors
- Reluctance motors
- Synchronous motors
- Special motors

- Motor running is controlled by characteristic.
- Voltage of motor is altered proportional to output frequency of inverter.

Sensorless Flux Control (SFC):

- Asynchronous motors

- Calculation of the rotor speed and the rotor angle from the electrical variables.
- High torque output based on field orientation (calculation of the currents to be set).
- High dynamics and smooth running
- Operation **without** encoder

Field-Oriented Regulation (FOR):

- Asynchronous motors

- Calculation of the rotor speed and rotor angle from the encoder information.
- Very high torque output based on field orientation (calculation of the currents to be set).
- Maximum dynamics and smoothness
- Operation **with** HTL encoder

Properties of the motor control methods in comparison

Properties	VFC Voltage Frequency Control	SFC Sensorless Flux Control	FOR Field-Oriented Regulation
Torque rise time	20-30 ms	< 2 ms	< 2 ms
Dynamic disturbance correction	NO	YES	YES
Standstill torque	NO	NO	YES
Acceleration torque[1)]	$1.2 \cdot M_{Nom}$	$1.8 \cdot M_{Nom}$	$2 \cdot M_{Nom}$
Current usage of inverter	60%	90%	100%
Anti-stall protection	Limited	YES	YES

Table 6.1 Motor control method

Properties	VFC Voltage Frequency Control	SFC Sensorless Flux Control	FOR Field-Oriented Regulation
Speed adjustment range $M = M_{Nom}$	1:20	1:20	>1:10000
Static speed accuracy	typically 1 to 5%[2)]	typically 1%[2)]	quartz accurate[2)]
Frequency resolution	0.01 Hz	0.0625 Hz	2^{-16} Hz
Motor principle	Asynchronous Synchronous Reluctance	Asynchronous	Asynchronous
[1)] $I_{Inverter} = 2 \cdot I_{Motor}$	[2)] Referred to the rated speed		

Table 6.1 Motor control method

General points on operation of three-phase AC motors with frequency inverters

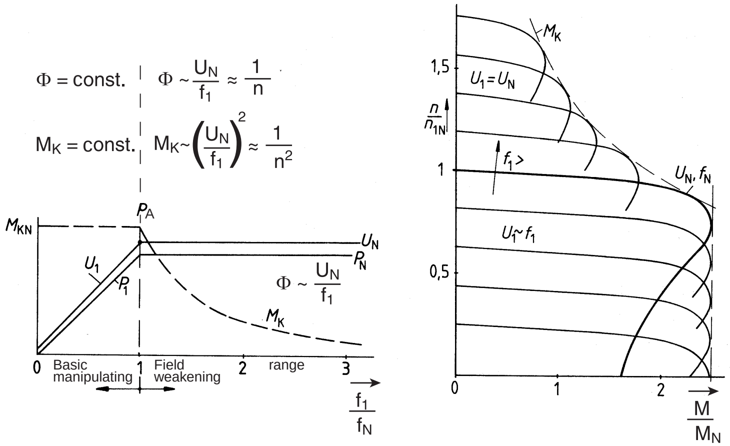


Figure 6.1 Characteristic of speed curves

Three-phase AC machines are executed in synchronous and asynchronous design. Their stator windings are arranged and their electrical properties designed such that in operation in a three-phase AC system a rotating field is created in the motor which drives the rotor.

The synchronous speed (n_S) of a motor is determined by the number of pole pairs (P) and the feed frequency (f_1) of the stator.

$$n_s = \frac{f_1 \cdot 60}{p}$$

Based on the induction from the stator rotating field, asynchronous motors develop a torque which drives the rotor and which attempts to reduce the speed relative to the stator rotating field and thus to counteract the cause of induction. Without the induction of a voltage in the rotor, however, no current (i_2) capable of forming a torque will flow. Consequently, a relative difference is established between the stator speed (n_1) and the rotor speed (n), which is defined as the slip (s).

$$s = \frac{\Delta n}{n_1} = \frac{n_1 - n}{n_1}$$

The asynchronous operating speed (n_b) is thus composed of the synchronous speed (n_S) and the slip (s).

$$n_b = \frac{f_1 \cdot 60}{p} \cdot (1 - s)$$

Low-loss speed control is only possible by means of a change of frequency. In order to retain a constant motor torque in the event of a speed adjustment, the magnetic flux Φ_1 in the stator winding must remain constant. The voltage U_1 must therefore be adjusted proportional to the stator frequency f_1.

$$M \sim \Phi_1 \cdot i_2 \quad \text{and} \quad \Phi_1 \sim \frac{U_1}{f_1}$$

A frequency/speed adjustment by means of the frequency inverter thus results in a parallel shift of the characteristic in the basic setting range along the speed axis (see Figure 6.1 diagram on right).

If the stator frequency is increased further when the rated frequency $f_N$and rated voltage U_N are reached, even though the maximum output voltage of the frequency inverter has been reached (U=Const.), the result is a field weakening.

As the speed rises, this results in a drop in torque with

$$M \sim \frac{1}{n^2}$$

General points on the interaction between control methods and motors

If control methods such as SFC and FOR are used for speed control, the correct motor data are decisive factors in terms of the quality of the methods.

During auto-tuning of the inverter module, all controllers are optimally set up based on the rating plate data and the automatically calculated electrical motor parameters.

If the motor data from the rating plate do not exactly match the actual electrical data of the motor, the control quality decreases. If the rated speed n_n is imprecisely specified, for example, the number of pole pairs may be incorrectly calculated or an unfavourable motor flux may be set. All further controller settings will then also be incorrect.

As already outlined, this will negatively affect the dimensioning and optimization of the controllers.

6.1 Voltage Frequency Control (VFC)

The multiplicity of functions of Voltage Frequency Control does not permit unrestricted simultaneous usage. However, in many cases it is possible to sequence functions such as DC braking followed by DC holding.

Combination of V/F characteristic functions

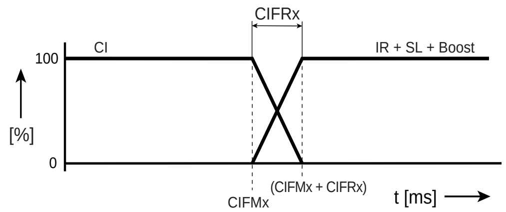
1st active function → / 2. Activate 2nd function ↓	Remagnetization	Current injection	IxR load compensation	Slip compensation	Current-controlled startup	DC braking	DC holding	Anti-oscillation
Remagnetization								
Current injection			❍	❍				
IxR load compensation		❍		✓	✓			✓
Slip compensation		❍	✓		✓			⊘
Current-controlled startup			✓	✓				✓
DC braking								
DC holding								
Anti-oscillation			✓	⊘	✓			

☐ Combination not active simultaneously, but activatable within a data set

✓ Simultaneous combination possible without restriction

❍ In a fixed frequency range both functions may overlap and thus restrict simultaneous working:
In a fixed frequency range both functions may overlap and thus restrict simultaneous working.

⊘ Combination not possible



II: Current injection; IR: IxR load compensation; SL: Slip compensation
CIFMx: Limit frequency of current injection

Figure 6.2 Combination of V/F characteristic functions

Setting when motor power output = inverter output

When using an asynchronous IEC standard motor no auto-tuning is needed. When using special motors, auto-tuning is required despite the identical power outputs.

Note: In the factory setting the inverter module is preset to a 1:1 ratio between the inverter output and the power output of the asynchronous standard motor.

Settings when motor power output < inverter output

Auto-tuning affects the functions listed in the table below. Auto-tuning is required with asynchronous special motors where the ratio between motor and inverter output is other than 1:1.

Function	Active in FS
Magnetization	
IxR load compensation	✔
Slip compensation	
DC braking	
DC holding	
Current injection	✔ (from firmware V 1.4)
Current-controlled startup	✔

Table 6.2 Generally applied functions in open-loop control mode VFC

Note: The factory setting of the inverter module is Voltage Frequency Control with 50 Hz characteristic over two interpolation points. IxR load compensation and current injection are additionally activated.
Please refer to the information given in the relevant sections regarding the IxR load compensation and current injection software functions.

6.1.1 _70VF-V/F characteristic

Function	Effect
• Adaptation of the inverter module to the motor and to the load characteristic of the application	• Generation of the optimum torque for the application.

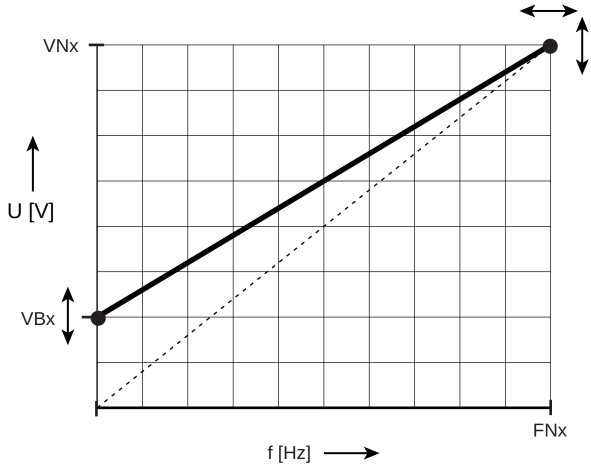


Figure 6.3 V/F characteristic with two interpolation points

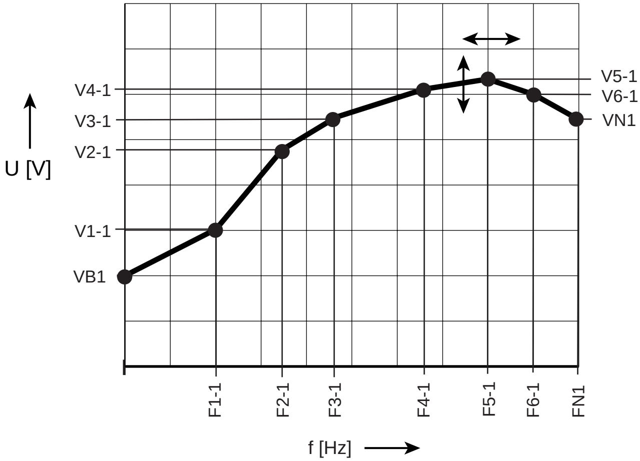
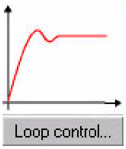
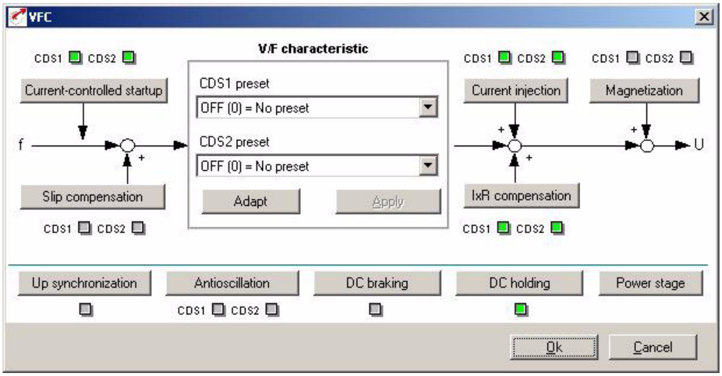


Figure 6.4 V/F characteristic with two interpolation points

1.


Loop control...

2.


VFC
V/F characteristic
CDS1 CDS2
Current-controlled startup
f
Slip compensation
CDS1 CDS2
CDS1 preset
OFF (0) = No preset
CDS2 preset
OFF (0) = No preset
Adapt
Apply
CDS1 CDS2
Current injection
CDS1 CDS2
Magnetization
U
IxR compensation
CDS1 CDS2
Up synchronization
Antioscillation
CDS1 CDS2
DC braking
DC holding
Power stage
Ok
Cancel

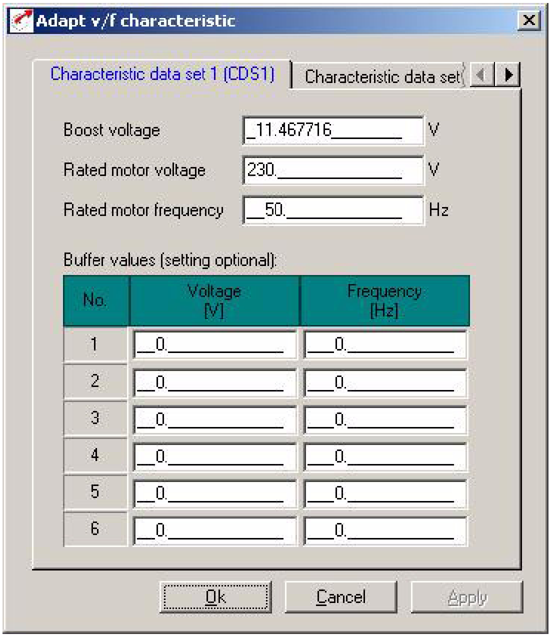


Figure 6.5 Adaption of V/F characteristic

Parameters of V/F characteristic

Parameter	Function	Value range	FS	Unit	Online
700-VB1	CDS1: Boost voltage	0 ... 100	0	V	
701-VN1	CDS1: Rated motor voltage	0 ... *	*	V	
702-FN1	CDS1: Rated motor frequency	0 ... 1600	50	Hz	
703-V1-1	CDS1: Voltage buffer value 1	0 ... *	0	V	
704-V2-1	CDS1: Voltage buffer value 2	0 ... *	0	V	
705-V3-1	CDS1: Voltage buffer value 3	0 ... *	0	V	
706-V4-1	CDS1: Voltage buffer value 4	0 ... *	0	V	
707-V5-1	CDS1: Voltage buffer value 5	0 ... *	0	V	
708-V6-1	CDS1: Voltage buffer value 6	0 ... *	0	V	
709-F1-1	CDS1: Frequency buffer value 1	0 ... 1600	0	Hz	
710-F2-1	CDS1: Frequency buffer value 2	0 ... 1600	0	Hz	
711-F3-1	CDS1: Frequency buffer value 3	0 ... 1600	0	Hz	
712-F4-1	CDS1: Frequency buffer value 4	0 ... 1600	0	Hz	

Table 6.3 Parameters from subject area _70VF V/F characteristic

Parameter	Function	Value range	FS	Unit	Online
713-F5-1	CDS1: Frequency buffer value 5	0 ... 1600	0	Hz	
714-F6-1	CDS1: Frequency buffer value 6	0 ... 1600	0	Hz	
715-VB2	CDS2: Boost voltage	0 ... 100	0	V	
716-VN2	CDS2: Rated motor voltage	0 ... *	*	V	
717-FN2	CDS2: Rated motor frequency	0 ... 1600	50	Hz	
718-V1-2	CDS2: Voltage buffer value 1	0 ... *	0	V	
719-V2-2	CDS2: Voltage buffer value 2	0 ... *	0	V	
720-V3-2	CDS2: Voltage buffer value 3	0 ... *	0	V	
721-V4-2	CDS2: Voltage buffer value 4	0 ... *	0	V	
722-V5-2	CDS2: Voltage buffer value 5	0 ... *	0	V	
723-V6-2	CDS2: Voltage buffer value 6	0 ... *	0	V	
724-F1-2	CDS2: Frequency buffer value 1	0 ... 1600	0	Hz	
725-F2-2	CDS2: Frequency buffer value 2	0 ... 1600	0	Hz	
726-F3-2	CDS2: Frequency buffer value 3	0 ... 1600	0	Hz	
727-F4-2	CDS2: Frequency buffer value 4	0 ... 1600	0	Hz	
728-F5-2	CDS2: Frequency buffer value 5	0 ... 1600	0	Hz	
729-F6-2	CDS2: Frequency buffer value 6	0 ... 1600	0	Hz	
730-ASCA1	CDS1: Assistance parameter for V/F characteristic	see Table 6.4	OFF		
731-ASCA2	CDS2: Assistance parameter for V/F characteristic	see Table 6.4	OFF		

Table 6.3 Parameters from subject area _70VF V/F characteristic

Explanatory notes

- The values marked with an asterisk (*) are dependent on device version 230 V or 400 V.
- CDS1 = Characteristic data set 1, CDS2 = Characteristic data set 2
- The voltages between two interpolation points are interpolated in linear mode.
- Interpolation points with the setting 0 Hz are inactive.
- The sequence of interpolation points is automatically sorted in ascending order of frequency. As a result, a new interpolation point can also be entered without having to shift other interpolation point settings.
- During controller initialization the limit values of the settings are checked. If the limit values are infringed an error message is delivered (see Appendix).

Settings of assistance parameters 730-ASCA1 and 731-ASCA2

The ASCA parameters contain preset characteristic shapes based on the setting options of the six interpolation points of the V/F characteristic.

BUS	KP/DM	Function	Usage
0	OFF	Fully programmable characteristic with up to six interpolation points	Optimum setting options for V/F control of special motors
1	L50Hz	Linear 50 Hz characteristic with two interpolation points	Standard motor (European market)
2	L60Hz	Linear 60 Hz characteristic with two interpolation points	Standard motor (American market)
3	L87Hz	Linear 87 Hz characteristic with two interpolation points	Expanded manipulating range for Δ
4	Q50Hz	Square 50 Hz characteristic with six interpolation points	Standard motor (European market) for pump and fan applications
5	Q60Hz	Quadratic 60 Hz characteristic with six interpolation points	Standard motor (American market) for pump and fan applications

Table 6.4 Setting of predefined V/F characteristics

87 Hz characteristic for expanded manipulating range

The operating range with constant torque of a 400 V / 50 Hz motor in star configuration can be expanded to 87 Hz in delta configuration.

Note: It should be checked whether the motor is adequate to the load (400 V / Δ at 87 Hz), since the motor can be run above its rated power. Only the motor manufacturer can give precise information.

Example: Expanded manipulating range based on 87 Hz characteristic

1. Motor data taken from rating plate

- Motor type: Asynchronous motor
- Rated power: 4 kW
- Rated speed: 1420 min^{-1}
- Rated voltage: 230 V / **400 V**
- Circuit: Δ / Y

2. Change motor circuitry on terminal board

- Change motor from star configuration (400 V / Y) to delta configuration (230 V / Δ).

3. Adapt power output of inverter module

- As a result of the changed configuration of the motor (400 V / Δ) the power of the inverter module must be adjusted.

Condition: $P_{Inverter} \geq P_{Motor} \cdot \sqrt{3}$

$$P_{Inverter} = (4kW \cdot 1{,}73)$$

➢ **Selected inverter module: CDA34.017 (rated power 7.5 kW)**

4. Adapt motor data entry in "Initial commissioning" subject area.

a) 154-MOPNM = $P_{n50Hz} \times \sqrt{3}$
b) 155-MOVNM = 400 V
c) 156-MOFN = 87 Hz
d) 157-MOSNM = $n_{n50Hz} \times \sqrt{3}$
e) 158-MOCNM = $I_{\Delta Motor}$

5. Drive diagram of 87 Hz characteristic

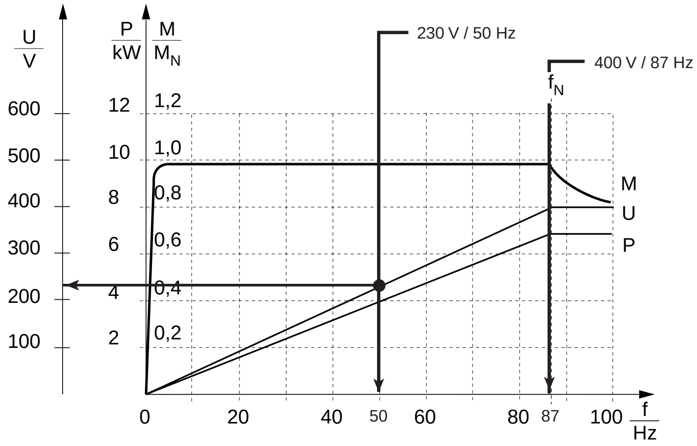


Figure 6.6 Constant torque range to 87 Hz

Note: Auto-tuning must be repeated following input of the converted motor data (see section 5.1 "_15FC-Initial commissioning").

6.1.2 _74IR-IxR load compensation

Function	Effect
• Automatic adaptation of the V/F characteristic to the load situation • Compensation for voltage drop on motor stator resistor	• In case of load surges a higher torque is available • The motor heats up less under load

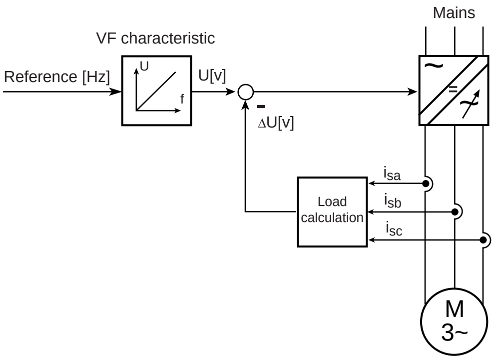
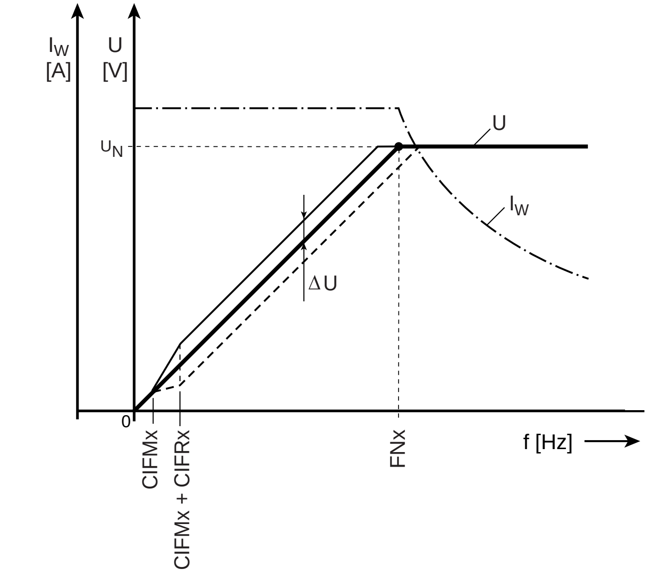


Figure 6.7 IxR load compensation block diagram

IxR load compensation is implemented by shifting the V/F characteristic by a voltage amount ΔU dependent on the effective current. The V/F characteristic is determined by the parameters from subject area "_70VF-V/F characteristic".

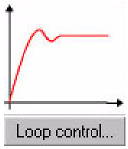
IxR load compensation: IxR=ON



I_W	Effective current
U	Output voltage
U_N	Rated voltage
CIFMx	Initial frequency
ΔU	Voltage adaptation by IxR load compensation

Figure 6.8 V/F characteristics of IxR load compensation

1.



2.

3.

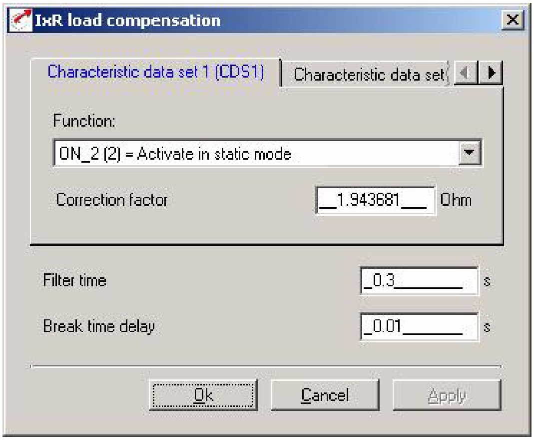


Figure 6.9 Adaptation of IxR load compensation

Parameters of IxR load compensation

Parameter	Function	Value range	FS	Unit	Online
740-IXR1	CDS1: IxR load compensation on/off	OFF, ON, ON_2	ON_2		✔
741-KIXR1	CDS1: IxR correction factor	0 ... 100	*	Ω	
742-IXR2	CDS2: IxR load compensation on/off	OFF, ON, ON_2	ON_2		✔
743-KIXR2	CDS2: IxR correction factor	0 ... 100	*	Ω	
744-IXRTF	Filter time constant for IxR compensation	0.0005 ... 20	0.3	s	
755-IXRTV	Switch-off time constant for IxR compensation	0.0005 ... 20	0.01	s	

Table 6.5 Parameters from subject area _74IR IxR load compensation

Explanatory notes

- The precondition for IxR load compensation is correct setting of parameters 159-MOCOS (cosφ) and 158-MOCNM (rated motor current I_{NM}).
- If the output frequency exceeds the rated motor frequency (parameter FNx), the IxR load compensation is deactivated.
- The stator resistance required for the function is automatically calculated during initial commissioning and stored in parameter KIXRx (IxR correction factor).
- Parameter values marked by an asterisk (*) in the "Factory setting" (FS) column are dependent on the device power output. The values correspond to an asynchronous IEC standard motor with the rated device power output - that is, a 1:1 rating.

Settings for 740-IXR1 and 742-IXR2

BUS	KP/DM	Function
0	OFF	IxR load compensation inactive
1	ON	IxR load compensation takes effect as from frequency CIFMx at 0% and is adjusted in linear mode up to 100% as from frequency CIFMx and CIFRx. Above that frequency it remains 100% active. IxR load compensation thus also takes effect during ramp-dependent acceleration (startup/rundown).
2	ON_2	IxR load compensation takes effect when the reference value is reached, meaning at the end of the acceleration phase. The "Reference-reached window" can be defined in subject area "_24CD-Digital outputs" (section 5.2.4) with parameter 230-REF_R. IxR load compensation becomes inactive as soon as the "Reference-reached window" is quit. The switch-off transition is regulated by way of a delay element and can be set with parameter 755-IXRTV.

Table 6.6 Setting of predefined V/F characteristics

1
2
3
4
5
6
A

6.1.3 _75SL-Slip compensation

Function	Effect
• Increase output frequency proportional to the load on the motor	• Compensation for the slip caused by the load on the motor, thus producing a constant speed

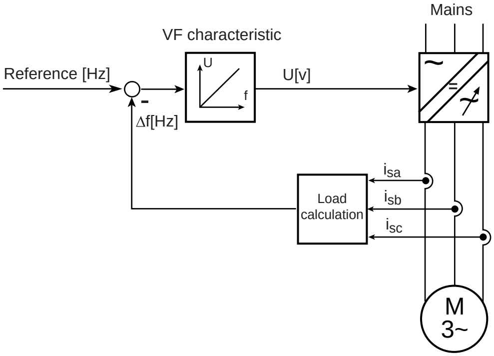
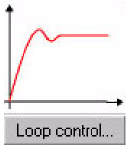


Figure 6.10 Slip compensation block diagram

1.



2.

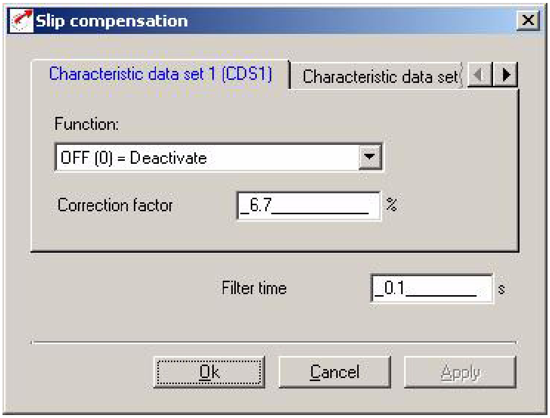


Figure 6.11 Adaptation of slip compensation

Parameters of slip compensation

Parameter	Function	Value range	FS	Unit	Online
750-SC1	CDS1: Slip compensation on/off	OFF, ON	OFF		✔
751-KSC1	CDS1: Slip compensation correction factor	0 ... 30	*	%	
752-SC2	CDS2: Slip compensation on/off	OFF, ON	OFF		✔
753-KSC2	CDS2: Slip compensation correction factor	0 ... 30	*	%	
754-KSCTF	Filter time constant for slip compensation	0.0005 ... 20	0.01	s	

Table 6.7 Parameters from subject area _75SL Slip compensation

Explanatory notes

- Parameter values marked by an asterisk (*) in the "Factory setting" (FS) column are dependent on the device power output. The values correspond to an asynchronous IEC standard motor with the rated device power output.
- The precondition for slip compensation is correct setting of parameters MOCOS (cosφ) and MOCNM (rated motor current I_{NM}).
- A frequency correction proportional to the effective current is added to the reference frequency. Slip compensation takes effect as from frequency CIFMx and is 100% active as from frequency CIFMx + CIFRx.
- The correction factor KSCx required for the function is automatically calculated during initial commissioning and stored in parameter KSCx.
- In the factory setting the correction factor for an IEC standard motor is stored with a ratio of inverter to motor of 1:1.
- The frequency correction Δf may be positive or negative, depending on whether motorized or regenerative operation is selected.

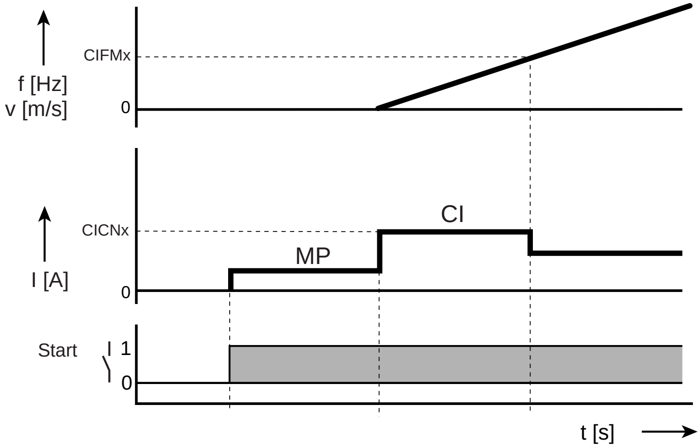
Note for control engineers: The correction factor KSC can be calculated by the following equation:

$$KSCx = \frac{n_{synch} - n_{nom}}{n_{synch}} \cdot 100\%$$

Note: If the slip compensation and the IxR load compensation influence each other, increasing the filter time of the slip compensation may bring a remedy.

6.1.4 _76CI-Current injection

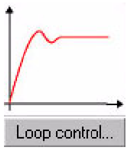
Function	Effect
• Current injection via current control as from a parameter-izable limit value as a per-centage of device rated current	• Increase the starting torque up to the set limit frequency



CIFMx Limit frequency of current injection
CICNx Reference for current injection
MP Magnetization, not active in FS
CI Current injection

Figure 6.12 Effective range of current injection (CI)

1.



2.

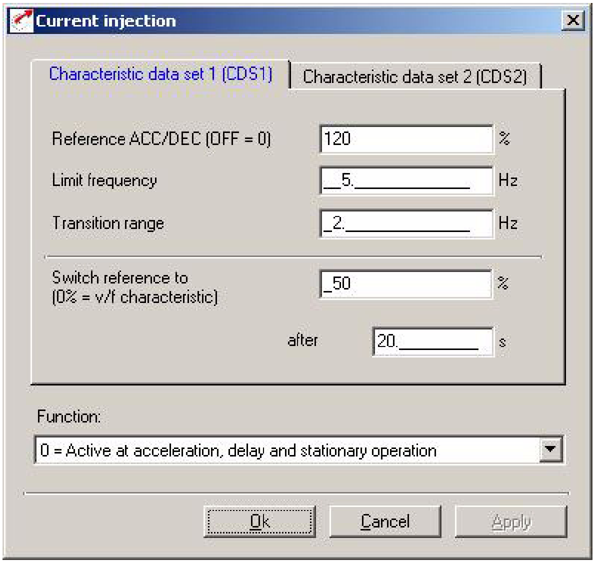


Figure 6.13 Adaptation of current injection

Parameters of current injection

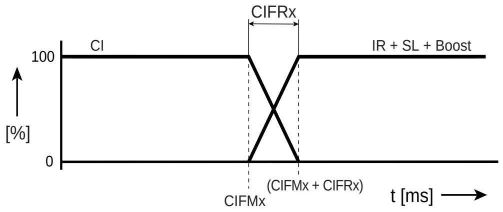
Parameter	Function	Value range	FS	Unit	Online
760-CICN1	CDS1: Current injection reference	0 ... 180	120	%	
761-CIFM1	CDS1: Current injection limit frequency	0 ... 100	4	Hz	
762-CIFR1	CDS1: Current injection transition range	0.5 ... 10	2	Hz	
763-CICN2	CDS2: Current injection reference	0 ... 180	120	%	
764-CIFM2	CDS2: Current injection limit frequency	0 ... 100	4	Hz	
765-CIFR2	CDS2: Current injection transition range	0.5 ... 10	2	Hz	
766-CITM1	CDS1: Current injection timer for switchover to CICT1	0 ... 60	6	s	
767-CICT1	CDS1: Current injection reference at end of CITM1	0 ... 180	30	%	
768-CITM2	CDS2: Current injection timer for switchover to CICT2	0 ... 60	6	s	
769-CICT2	CDS2: Current injection reference at end of CITM2	0 ... 180	30	%	

Table 6.8 Parameters from subject area _76CI Current injection

Explanatory notes

- In the frequency range CIFRx the current injection is regulated back to the normal operating current as from the limit frequency CIFMx.
- In conjunction with IxR load compensation and slip compensation, current injection can only operate simultaneously to a limit degree in the startup phase.
- In the factory setting the magnetization phase is not active in VFC mode.
- With CIFMx=0 the function can be deactivated.

In a fixed frequency range both functions may overlap and thus restrict simultaneous working.



CI: Current injection
IR: IxR load compensation
SL: Slip compensation
CIFMx: Limit frequency of current injection

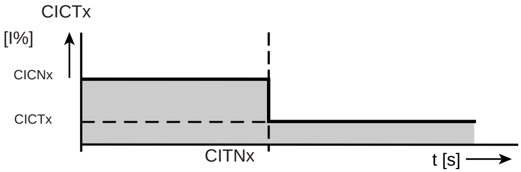
Note: When setting the parameter values manually in VFC mode, please pay attention to the information set out in section 6.1.7 "Tips and optimization aids for control engineers" (step 3), otherwise the "current-controlled startup" function may negatively affect the "current injection" function.

Note: The current injection reference is a percentage of the device rated current (I_{GN}) of the inverter module.
Up to firmware V1.35 at motor power outputs < inverter output the reference should be adjusted manually to 80% of the rated motor current (I_{MN}).

$$CICNx = \frac{I_{MN}}{I_{GN}} \cdot 80\%$$

From firmware V1.4 the adjustment is made during auto-tuning (see section 5.1 "_15FC-Initial commissioning") to 100% of the motor rated current.

From firmware V2.10 the adjustment is made during auto-tuning to 120% of the motor rated current up to 1.5 times the motor rated slip. This limit frequency CIFMx is likewise automatically calculated during auto-tuning. Also, after the time CITMx the injected current is reduced to CICTx.



Attention! Motors with internal cooling:
When application data sets DRV_4, DRV_5, ROT_2, ROT_3, M-S_2 or M-S_4 are switched from closed-loop control mode 300-CFCON=FOR to open-loop control mode VFC, parameter 597-RF0=0Hz from subject area _59DP Driving profile generator must be set to OFF. Otherwise at standstill a current in the amount of CICNx will be injected which may over time destroy the motor by overheating, because internally cooled motors have no fan cooling when at a standstill.

6.1.5 _73AP-Anti-oscillation

Function	Effect
• Oscillations of the motor are compensated by automatic reference value changes	• The oscillation of a motor is compensated • Minimization of oscillation amplitude

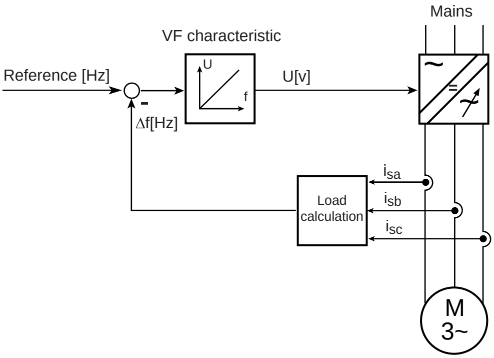
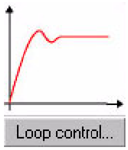


Figure 6.14 Anti-oscillation block diagram

1.



2.

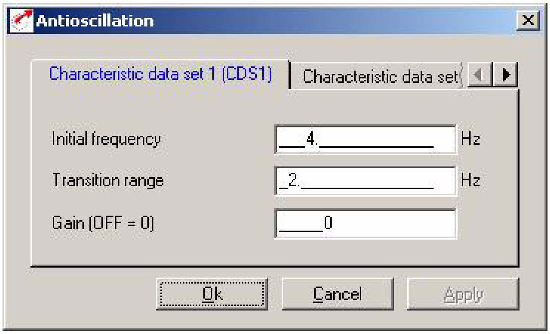


Figure 6.15 Adaptation of anti-oscillation

The anti-oscillation acts by altering the reference value of the loop control. The reference is influenced by a value proportional to the change in the effective current. Based on the effective current the periodic oscillation can be plotted.

Parameters of anti-oscillation

Parameter	Function	Value range	FS	Unit	Online
732-APFL1	CDS1: Anti-oscillation limit frequency	0 ... 1600	4	Hz	
733-APFR1	CDS1: Anti-oscillation transition range	0.5 ... 10	2	Hz	
734-APGN1	CDS1: Anti-oscillation gain	-19999 ... 19999	0		✔
735-APFL2	CDS2: Anti-oscillation limit frequency	0 ... 1600	4	Hz	
736-APFR2	CDS2: Anti-oscillation transition range	0.5 ... 10	2	Hz	
737-APGN2	CDS2: Anti-oscillation gain	-19999 ... 19999	0		✔

Table 6.9 Parameters from subject area _73SL Anti-oscillation

Explanatory notes

- Anti-oscillation is disabled in the factory setting (FS).
- Slip compensation and anti-oscillation are antivalent, i.e. they are not simultaneous in function (with slip compensation active anti-oscillation is inactive).
- The effective range of the current injection and the anti-oscillation must not overlap.
- The anti-oscillation is not preset by auto-tuning. It must be optimized manually as required.
- In the transition range the anti-oscillation is activated in ascending order from 0% to 100%.

Note on optimization

With the aid of the DRIVEMANAGER scope function the oscillation of the motor can be checked and the action of the anti-oscillation optimized.

Scope setting:

Channel	Recording variable	Unit	Abbreviation
0	Control reference	Hz	refvalue
1	/	/	/
2	Effective current after filter for slip compensation	A	iw_sleep
3	/	/	/

Table 6.10 Scope setting to optimize the anti-oscillation function

By changing the gain and the field of application, the oscillation amplitude of the effective current can be minimized. The lower the oscillation amplitude the lower the swing motion of the rotor.

1 2 3 4 5 6 A

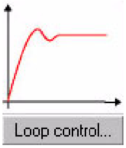
DE EN

6.1.6 _63FS-Up synchronization

Function	Effect
• A small detection current determines the current frequency of the rotating motor	• Up synchronization of the rotating field of the frequency inverter to a rotating motor • Smooth Up synchronization

The Up synchronization is effected by injection of a low detection current with a changing frequency. Maximum frequency and the last direction specified are assumed. By influencing the detection current a smooth Up synchronization can be achieved. Before activating the frequency inverter rotating field for operation of the motor a demagnetization phase is run through. Then the obtained rotation frequency is activated.

1.



2.

3.

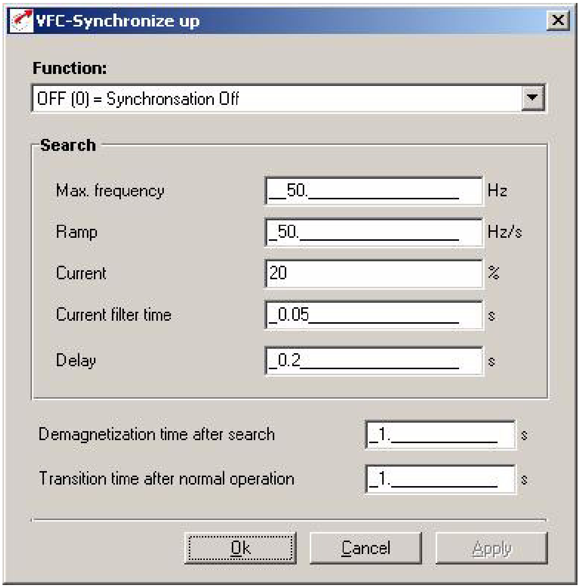


Figure 6.16 Adaptation of Up synchronization

Parameters of Up synchronization

Parameter	Function	Value range	FS	Unit	Online
630-FSSEL	Search mode for Up synchronization	off/on	off		
631-FSFMX	Maximum frequency during searching in Up synchronization	0 ... 1600	50	Hz	
632-FSRMP	Ramp during searching in Up synchronization	1 ... 999	50	Hz/s	
633-FSCL	Current during searching in Up synchronization	10 ... 60	20	%	
634-FSOND	Demagnetization time in Up synchronization	0.05 ... 60	1	s	
635-FSSTD	Search delay in Up synchronization	0.05 ... 60	0.2	s	
636-FSVFD	Transition time to normal mode in Up synchronization	0.05 ... 60	1	s	
637-FSTF	Filter time constant for effective current during Up synchronization	0.0005 ... 20	0.01	s	

Table 6.11 Parameters from subject area _63FS Up synchronization

Explanatory notes

- The "Up synchronization" function is disabled in the factory setting (FS).
- By adjusting the detection current 633-FSCL the Up synchronization can be run smoothly, and acceleration of the motor toward the rotation frequency of the detection current can be avoided.
- The detection current 633-FSCL is scaled to the rated device current.
- The ramp of the search is adjusted during auto-tuning such that the search time from FMAXx to 0 Hz is 1 s.
- The maximum frequency during searching is adjusted to the maximum frequency FMAXx during auto-tuning.
- The Up synchronization preset relates to a drive rating of device to IEC standard motor at a ratio of 1:1. If there is a discrepancy, auto-tuning should be carried out to adjust the parameters based on an initial commissioning (see section 5.1 "_15FC-Initial commissioning").

6.1.7 Tips and optimization aids for control engineers

Generally the presets of the functions for IEC standard motors are adequate. However, the performance of special motors can be improved using the optimization aids.
The following section presents tips and optimization aids to deal with typical application errors.

Step	Checks	Help
1	Check that your wiring is connected properly and the phase sequence is correct	see section 2.1 "Device and terminal view"
2	**In IEC standard motors:** Enter correct (plausible) motor data and start auto-tuning.	see section 5.1 "_15FC-Initial commissioning"
	In special, reluctance or synchronous motors:	Continue with step 3
3	Check the current injection.	Optimization of current injection in this section.
4	Check the IxR load compensation.	Optimization of IxR load compensation in this section.
5	Check the boost voltage if no current injection is active.	Optimization of boost voltage in this section.
6	Check the interaction between current injection, IxR load compensation and boost voltage.	Optimization of the interaction in this section.
7	Check the V/F characteristic	Optimization of V/F characteristic in this section.

Table 6.12 Procedure for optimization of voltage frequency control

Note: Please take note of the general information regarding the properties of the motor control methods in the introduction to section 6 "Control modes".

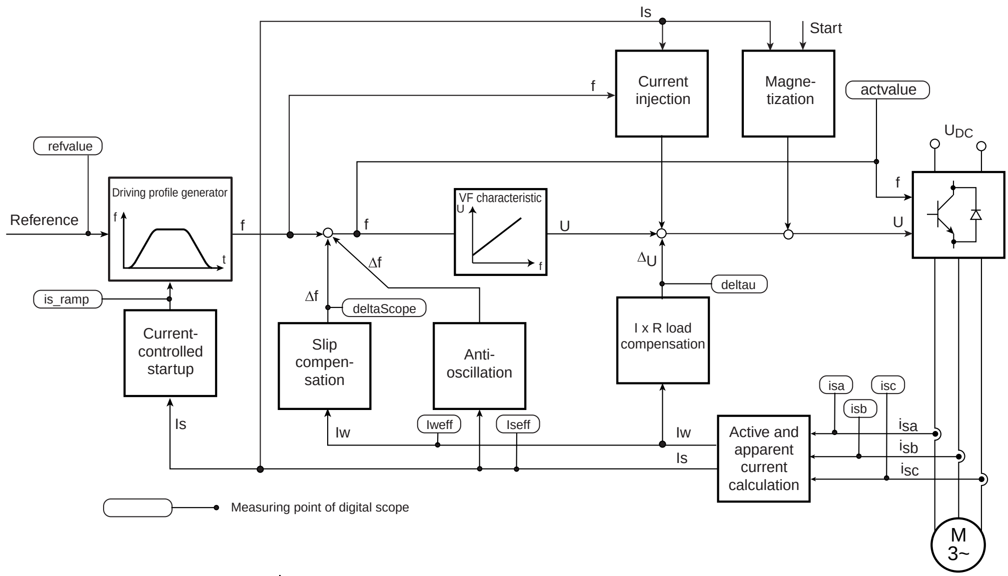


Figure 6.17   Block diagram of control circuit (VFC)

Recording variables of the scope function in the DRIVEMANAGER

Recording variable	Abbreviation	User level
Control reference	**refvalue**	**1**
Control actual value	**actvalue**	**1**
Frequency change by slip compensation	**deltaScope**	**3**
Voltage change by IxR	**deltau**	**3**
Phase current in phase U	**isa**	**1**
Phase current in phase V	**isb**	**1**
Phase current in phase W	**isc**	**1**
Apparent current after filter for current-controlled startup	**is_ramp**	**3**
Effective value of apparent current	**Iseff**	**1**
Effective value of effective current	**Iweff**	**1**

Table 6.13 Recording variables of the DRIVEMANAGER scope

Current injection

The current injection should be set to 1.5 times the slip frequency (FMx) and the reference value (CICNx) to 120% of the rated motor current.

Typical slip frequencies of asynchronous motors

Power	Typical slip frequency
to 15 kW	3-7 Hz
to 90 kW	up to 1 Hz

Table 6.14 Typical slip frequencies dependent on power group

Calculation of motor slip frequency

$$f_{Slip} = \frac{(n_{synchron} - n_{asynchron}) \cdot P}{60}$$

At rated motor frequency 50 Hz:

$$f_{Slip} = 50Hz - \frac{n_{asynchron} \cdot P}{60}$$

where

$n_{synchron}$:	synchronous speed of motor
$n_{asynchron}$:	asynchronous speed of motor
P:	number of pole pairs of asynchronous motor

Above the limit frequency (CIFMx) the current injection (reference CICNx) is regulated in linear mode over a transfer range (CIFRx) and then activated functions are inserted.

Note: The limit current of the current-controlled startup should be adjusted if the initial and lowering frequencies fall into the current injection range. For this, the initial (CLFRx) and lowering (CLFLx) frequencies should be set to at least the limit frequency of the current injection (CIFMx) +2 Hz. During the injection phase the boost voltage is not applied, because the set voltage is determined by the current injection.

IxR load compensation

4.

The stator resistance dependent on the effective current influences the control. The stator resistance as a correction factor KIXRx can be determined by measuring a winding phase with an ohmmeter.

Note: Pay attention to the circuit type of your motor.

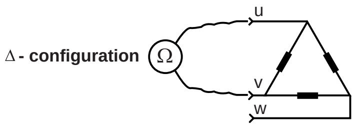
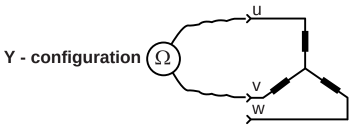
Circuit type	Measurement	Correction factor
Delta		$KIXR = \frac{2}{3} R_{meas}$
Star		$KIXR = \frac{1}{2} R_{meas}$

Table 6.15 Measurement of stator resistance dependent on circuit type

Boost voltage

By increasing the boost voltage the drive can be provided with more current for acceleration purposes in the lower frequency range. The rule here is: as much boost voltage as necessary, but as little as possible.

An unnecessarily high boost voltage will lead to overheating of the motor.

Note: During current injection the voltage to be set is determined by the control, in order to inject a constant current. Consequently, the current injection adopts the torque increase factor in the starting torque.

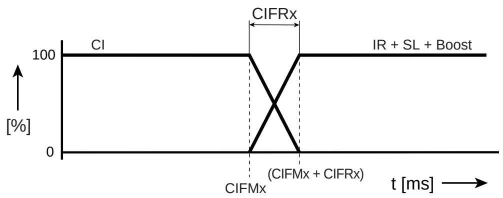
Calculation of boost voltage:

$$VNx = R_{Stator} \cdot I_{N-Motor}$$

6.

Interaction between current injection, IxR load compensation and boost voltage

As shown in Figure 6.18, the transition from current injection to IxR load compensation and boost / V/f characteristic is set by way of the current injection limit frequency.



CI: Current injection
IR: IxR load compensation
SL: Slip compensation
CIFMx: Current injection limit frequency

Figure 6.18 Combination of V/F characteristic functions

Since the stator resistance influences the control dependent on the effective current, if the transition from current injection to IxR load compensation is poor the IxR load compensation may cause oscillations in the voltage change. In critical configurations in the overload range of the frequency inverter this may lead to inverter shut-off, so it is advisable to perform the commissioning with no IxR load compensation.

Current injection and boost voltage

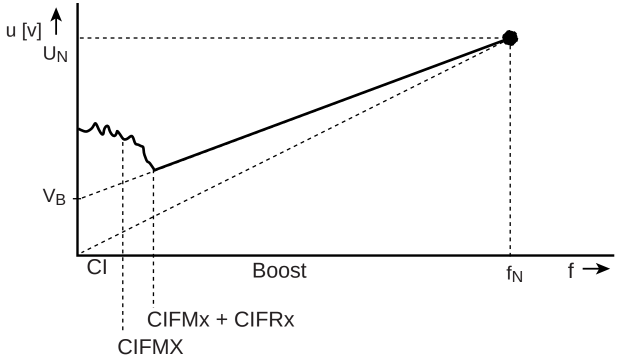
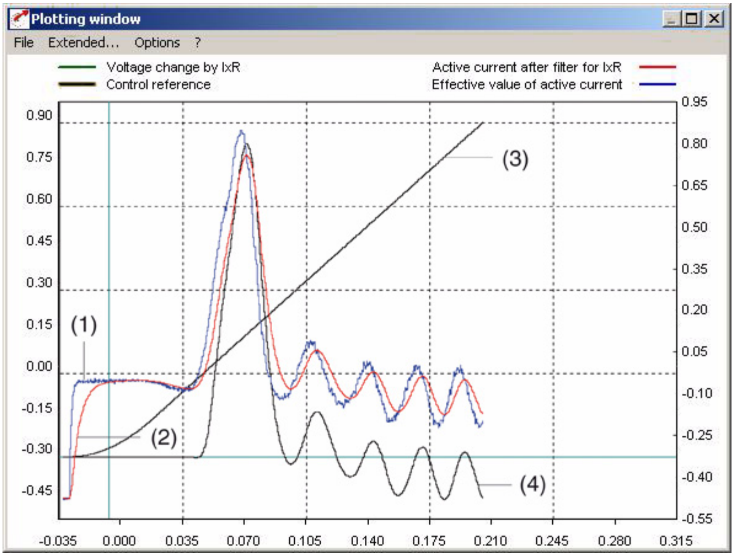


Figure 6.19 Combination of current injection and boost voltage

Since both functions are used to increase the startup torque and the current injection takes priority before the boost voltage, the diagram shows that the boost voltage should not be increased when both functions are activated.

The following example illustrates the relative current conditions when parameters are not optimized and when they are optimized in conjunction with IxR load compensation set to IXR=ON.

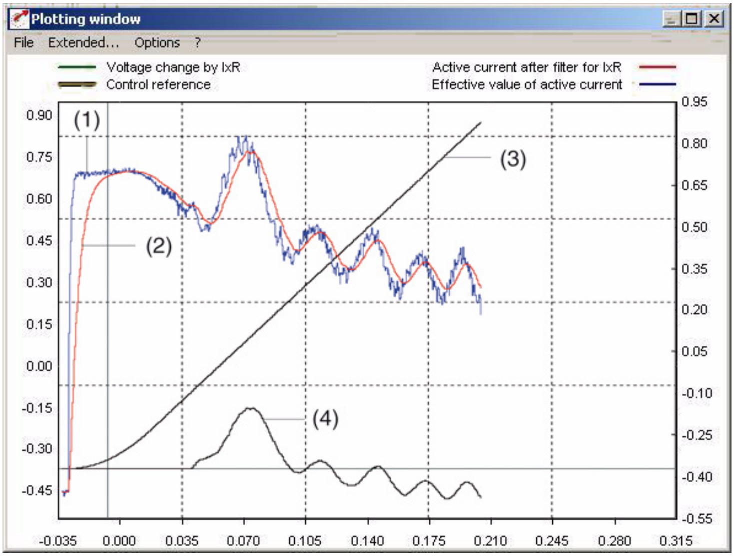
Non-optimized setup:



(1) Effective value of effective current
(2) Effective current after filter for IxR
(3) Control reference
(4) Voltage change by IxR

Figure 6.20 Scope recording with motorized load torque of 8 Nm on a 1.5 kW asynchronous motor with holding brake and 100% current injection

Optimized setup



(1) Effective value of effective current
(2) Effective current after filter for IxR
(3) Control reference
(4) Voltage change by IxR

Figure 6.21 Scope recording with motorized load torque of 8 Nm on a 1.5 kW asynchronous motor with holding brake and 120% current injection

Fazit: **The effective current in the optimum setup is lower by a factor of 2. This is based on a reduction of the slip during the startup phase, thereby improving the control transition.**

V/F characteristic

7.

The response of the drive can be influenced by the setting of the V/F characteristic parameters by means of interpolation points. If resonance points or oscillation occurs in the drive, it can be "quietened" by reducing the voltage in the calculated frequency range. The reduced voltage causes less current to be delivered to the drive. Conversely, purposely increasing the voltage can deliver more current to the drive in order to compensate for increased load torques, such as those caused by the mechanism. If the rotor swings the anti-oscillation function should be activated and optimized. The "slip compensation" function must not be active while doing so.

Tips for a simple drive solution

Sensible combinations of the various controllers in VFC mode results in a faster and safer drive solution. The following table merely sets out some tips as a guide for how the drive solution can be found more easily when the mechanism is very soft or stiff relative as opposed to typical applications.

Mechanism	Closed-loop control function	Note on setting
Rigid, i.e. low elasticity, no slack	IxR load compensation	IxR = ON_2
	Current injection	CICNx ≈ 120%
	Current-controlled startup	• Current limit value CLCLx ≈ 120% • Function CLSLx = CCWFR
Soft, i.e. high elasticity, much slack	IxR load compensation	IxR = ON_2 Filter time constant IxRTF ≈ 500 ms
	Driving profile generator	Smoothing JTIME ≈ 500 ms
	Anti-oscillation	Gain APGNx ≈ -1000...-3000
	Current injection	CICNx ≈ 80%

Table 6.16 Tips for a drive solution with an external mechanism

6.2 Sensorless Flux Control (SFC)

Please take note of the general information regarding the properties of the motor control methods in the introduction to section 6 "Control modes".

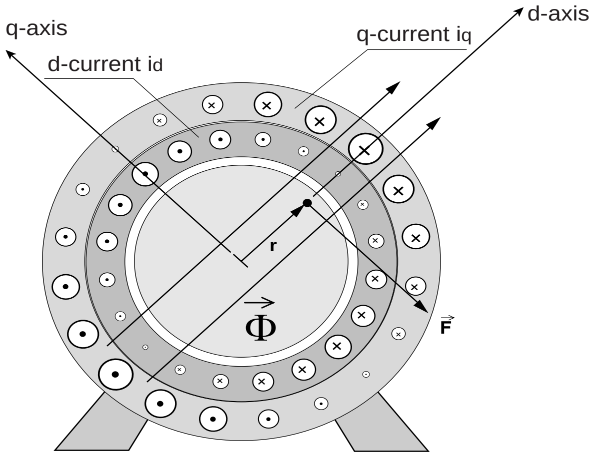
Note: Sensorless Flux Control is only suitable for asynchronous motors in standalone operation (not for multi-motor operation!).

Principle of Sensorless Flux Control

Sensorless Flux Control is based on activation of the motor with voltages which are oriented to the stator flux. To obtain stator flux orientation a machine model of the asynchronous motor of which the parameters can be calculated during auto-tuning is evaluated.

By transforming the currents and voltages into a system of coordinates oriented to the stator flux, the flux and torque formation can be analyzed in isolation from each other.

The stator flux angle ε_{FS} is estimated based on the measured current curves and the injected voltages. Consequently, the d- and q-currents and voltages are likewise estimates. The d-components of the current and voltage point in the direction of the stator flux and thus contribute to formation of the field (flux-forming). The 90° offset q-components of the current and voltage run transverse to the stator flux and form the torque. This correlation is illustrated in Figure 6.22.



$\vec{\Phi}$ Magnetic flux as vector

$\vec{F}$ Force as vector (FN ~ iq · Φ)

Figure 6.22 Principle of function of the asynchronous motor

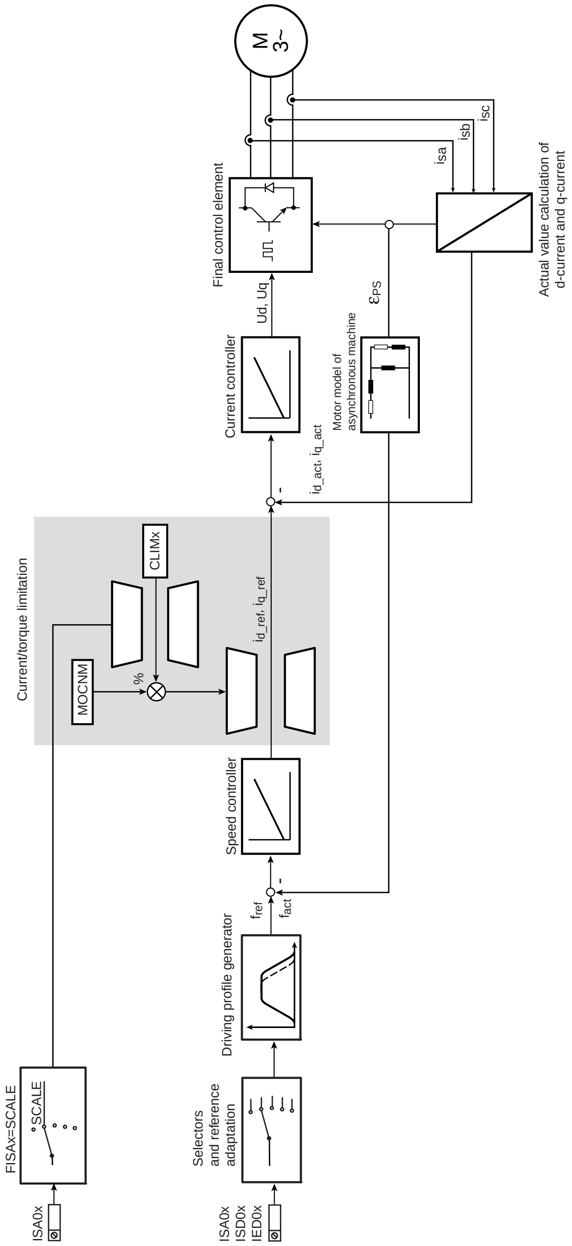


Figure 6.23 Sensorless Flux Control SFC

Software functions

In Sensorless Flux Control mode (SFC) not all functions of the inverter module are required. The following functions can be selected, but not all actively.

Functions in SFC

Designation	Abbreviation	Active function		Inactive function
		Simultaneous	Subsequent	
Current-controlled startup	_64CA	✔		
DC braking	_67BR		✔	
DC holding	_68HO		✔	
IxR load compensation	_74IR			✔
Slip compensation	_75SL			✔
Current injection	_76CI			✔
Remagnetization	_77MP	✔		

Table 6.17 Functions in conjunction with SFC

Explanatory notes

- In the event of strong load surges resulting in rapid speed changes, the stator flux orientation of the SFC may be lost, and current overload shut-offs (error E-OC) may occur. This is counteracted by the "current-controlled startup" function (see section 5.5.11) setting a steep lowering ramp.
- The DC braking and DC holding functions can only be sequenced. If both functions are activated the DC holding function is not activated until the braking time has elapsed. No check that the rotor has come to a standstill is made before activation of the holding time.
- Magnetization can be deactivated by way of parameter 774-MPT=0s in subject area "_77MP-Remagnetization". During auto-tuning the magnetization time is determined automatically.

Information for auto-tuning

For auto-tuning of the controller and motor parameters the rating plate data of the motor must be entered in the parameters of the " Initial commissioning" subject area (see section 5.1). Precise motor data should be obtained as necessary from the manufacturer.

The operating points of the motor are set based on these data, so precise information from the motor manufacturer is important.

Note: Auto-tuning determines the controller and motor parameters automatically and enters them in the relevant parameters.

In special application cases a further optimization of the parameters based on experimentation with the application may improve the result. Manual optimization is particularly advisable for applications in the limit zone of the electric power rating of the inverter module as well as in case of major load surges, or for special motors (e.g. high-frequency spindles). This optimization based on tests should bring the desired success in terms of the drive solution.

Note: During identification the switching frequency of the power stage should be reduced in subject area "_69PM-Modulation" by means of parameter 690-PMFS to 4kHz. This reduction improves the accuracy of motor identification, because the influence of the fault voltages of the inverter power stage is reduced. This measure can improve control response at inverter outputs above 22 kW (from CDA34.045).

6.2.1 _78SS- Speed controller SFC

Function	Effect
• Setting of speed control circuit	• Smooth running and good dynamics of the drive

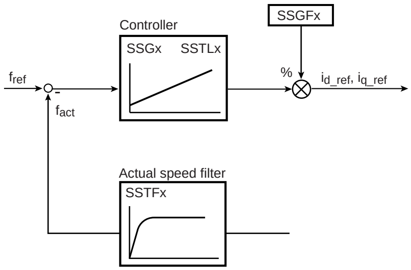
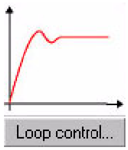


Figure 6.24 SFC speed controller

1.



2.

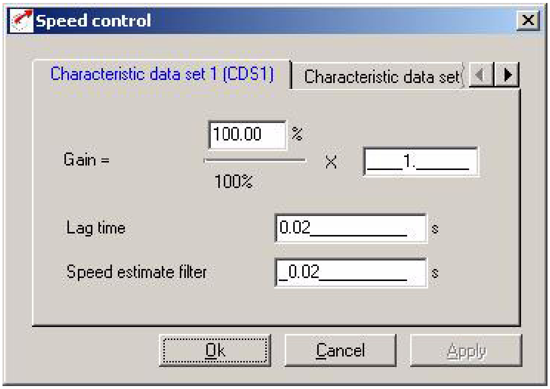


Figure 6.25 Adaptation of the SFC speed controller

Parameters of SFC speed controller

Parameter	Function	Value range	FS	Unit	Online
780-SSGF1	CDS1: Scaling of speed controller gain	0.00...999.95	100	%	✔
781-SSG1	CDS1: Speed controller gain	0...16383	1		
782-SSTL1	CDS1: Speed controller lag time	0.001...2	0.02	s	
783-SSTF1	CDS1: Filter time constant of speed estimate	0.0005...20	0.02	s	
784-SSGF2	CDS2 Scaling of speed controller gain	0.00...999.95	100	%	✔
785-SSG2	CDS2: Speed controller gain	0...16383	1		
786-SSTL2	CDS2: Speed controller lag time	0.001...2	0.02	s	
787-SSTF2	CDS2: Filter time constant of speed estimate	0.0005...20	0.02	s	

Table 6.18 Parameters of SFC speed controller

Explanatory notes

- All controllers are set by the initial commissioning. With the speed controller SFC and the current controller (see section 5.10) it is possible to make fine adjustments of the controller properties to the application where necessary.
- The dimensioning of the speed control circuit is based on the values specified by auto-tuning for the motor and system moments of inertia. If the value 0 is entered the inverter module enters estimated moments of inertia for the motor and the system (see section 5.1).
- The speed controller gain is adapted by way of the scaling parameter SSGFx according to the requirements of the application.

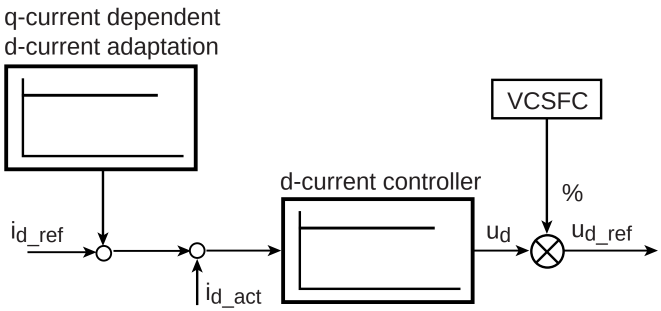
Controller setting	Effect
SSGFx low	• Long rise times, slow control response • Disturbance compensation slow, the controller appears undynamic
SSGFx high	• Short rise times, fast control response • Disturbance compensation fast, the controller appears dynamic • Speed is noisy • High noise

Table 6.19 Response of the speed controller

6.2.2 _80CC-Current controller

Function	Effect
• Setting of current controller functions	• Parameter setting of the PI current controller

Magnetic flux forming current i_d



Torque forming current i_q

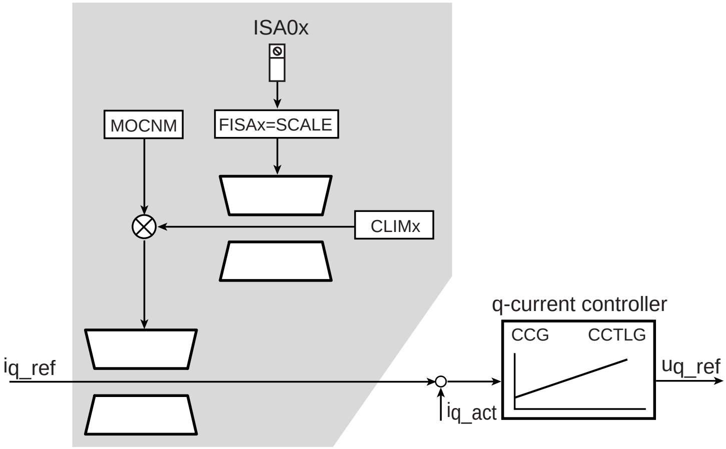
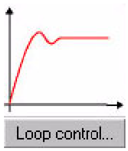


Figure 6.26 SFC current controller

1.



2.

3.

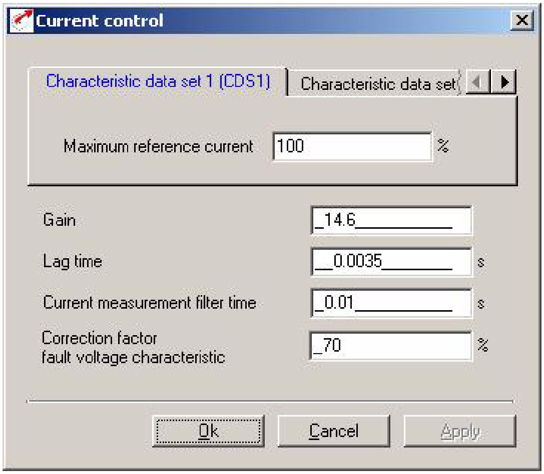


Figure 6.27 Adaptation of the current controller

Parameters of current control

Parameter	Function	Value range	FS	Unit	Online
800-CCG	Current controller gain	0...500	48		
801-CCTLG	Current controller lag time	0.001...100	0.0036	s	
802-CCTF	Filter time constant for current measurement in SFC	0.0005...20	0.01	s	
803-VCSFC	Correction factor of fault voltage characteristic SFC	0...199	*	%	✔
804-CLIM1	CDS1: Maximum reference current for current control	0...180	100	%	
805-CLIM2	CDS2: Maximum reference current for current control	0...180	100	%	

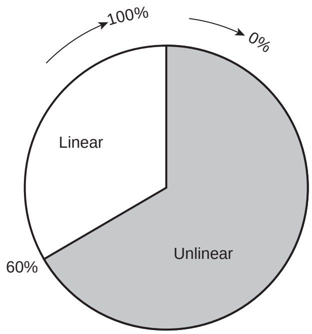
Table 6.20 Parameters of subject area _80CC Current control

Explanatory notes

- The filter time constant for current measurement is used only by the Sensorless Flux Control (SFC) control mode.
- The parameters of the current controller are set automatically during auto-tuning in the initial commissioning phase. It is not necessary to change the obtained values of the PI controller for the gain (800-CCG) and the lag time (801-CCTLG).
- The d-current is regulated to its reference value by the PI current controller.
- The d-current is regulated with a P controller.
- The D-current generally deviates from its reference value. It can be optimized with the aid of parameter VCSFC, which permits adjustment of the fault voltage characteristic to the application online (see section 6.2.3 "Tips and optimization aids for control engineers", section headed "Optimization of d-current").
- Parameter values marked by an asterisk (*) in the "Factory setting" (FS) column are dependent on the device power output. The values correspond to an asynchronous IEC standard motor with the rated device power output.

Additional notes on the other fields of application of the current controller are set out in section 5.5.10.

Note: The SCALE function via an analog input (FISAx=SCALE) only has sufficient linearity above a 60% ratio of reference to rated torque.



6.2.3 Tips and optimization aids for control engineers

The following presents a systematic procedure for setting of the control.

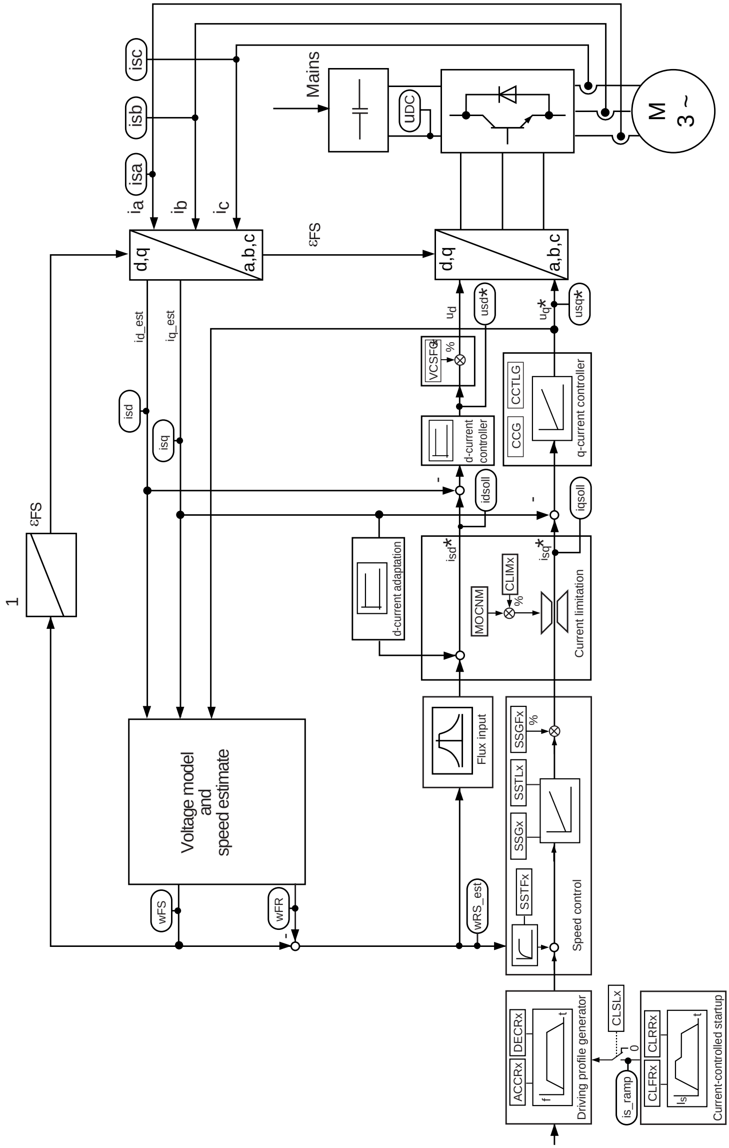
Note: In the event of strong load surges resulting in rapid speed changes, the stator flux orientation of the SFC may be lost, and current overload shut-offs (error E-OC) may occur. This error is counteracted by the "current-controlled startup" function (see section 5.5.11) setting a steep lowering ramp.

Step	Checks	Help
1	Check that your wiring is connected properly and the phase sequence is correct	see section 2.1 "Device and terminal view"
2	Enter correct (plausible) motor data and start auto-tuning	see section 5.1 "_15FC-Initial commissioning"
3	Check the fault voltage compensation	Optimization of the D-current in this section
4	Check the limit values for the apparent current	Setting of the current limitation in this section
5	Check the speed controller	Optimization of the speed controller in this section

Table 6.21 Procedure for optimization of SFC

Note: The phase currents are measured by hardware in all three phases. In control modes SFC and FOR, to speed up the controller computing time, the phase current of phase W is not calculated in the digital scope of the DRIVEMANAGER.

Structure diagram of SFC



Measuring points of the scope in the DRIVEMANAGER

Parameter

ε_{FS} Stator flux angle

* Reference

est Estimated value (by calculation)

Figure 6.28 Structure diagram of Sensorless Flux Control

Recording variables of the scope function in the DRIVEMANAGER

Recording variable	Abbreviation	User level
d-axle reference current	idref	4
q-axle reference current	iqref	4
d-axle current	isd	4
q-axle current	isq	4
Phase current phase U	isa	1
Phase current phase V	isb	1
Phase current phase W	isc	1
Apparent current after filter for current-controlled startup	is_ramp	3
DC-link voltage	udc	1
Slip frequency	wFR	4
Output frequency (SFC)	wFS	3
Rotor frequency	wRS_est	1

Table 6.22 Recording variables in the structure diagram of control with SFC

Optimization of the d-current

3.

Adaptation of the fault voltage characteristic

At low asynchronous motor resistances (e.g. in motors with higher power outputs) it may be necessary to optimize the current controller by fault voltage compensation by way of parameter 803-VCSFC in subject area "_80CC-Current controller".

Note: A compromise needs to be found between formation of a high torque at low speeds (VCSFC high) and stability of the control (VCSFC low).

Optimization instructions:

1. Run motor with reference 0 Hz (parameter 597-RF0 = 0 Hz) in subject area "_59DP-Driving profile generator"
2. Open scope and set the currents "d-axle current" (i_{sd}) and "d-axle reference current" (i_{sd_ref}). (Note: User level 4 required!)
3. Compare the currents and set them to the following ratio by way of parameter 803-VCSFC:

   "d-axle current" (i_{sd}) =0.9 * "d-axle reference current" (i_{sd_ref})

Example: ASM with P = 1.5 kW,
U_N = 400V,
I_{NY}= 3.7A in Y configuration
n_N = 1410 rpm

After auto-tuning the inverter module set parameter 803-VCSFC at 68 %. The following diagrams illustrate the effect of parameter 803-VSSFC.

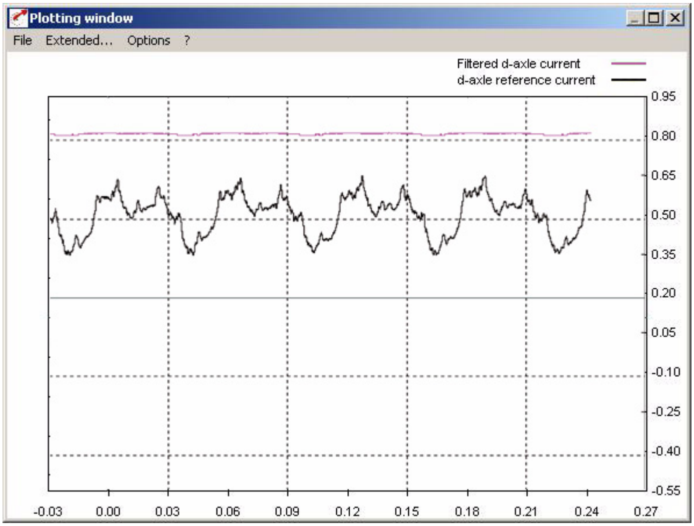


Figure 6.29 803-VCSFC = 199 %

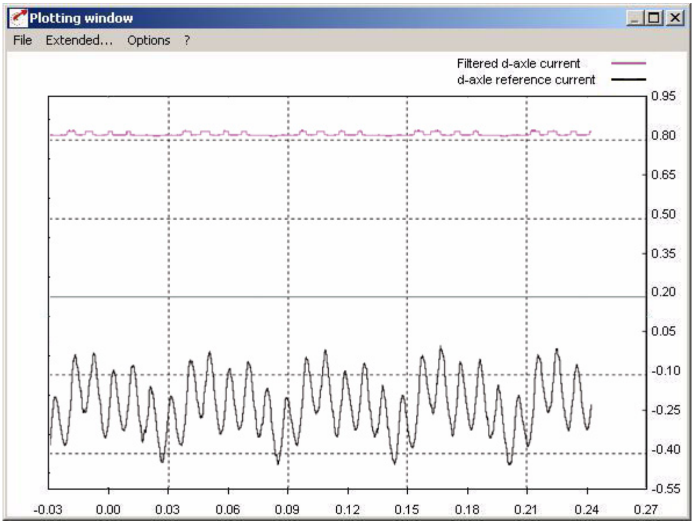


Figure 6.30 803-VCSFC = 0 %

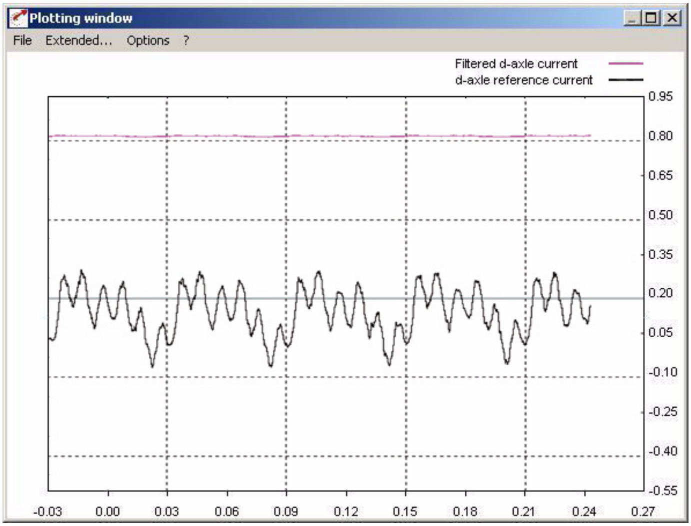


Figure 6.31 803-VCSFC = 68 % after calculation by auto-tuning

Note: If 803-VCSFC is too high the motor may rotate with maximum slip. This is indicated by the fact that the estimated speed (400-ACTF) is unequal to the specified reference speed and the current of the q-axle (i_{sq}) enters the device limit. It is also shown on the motor, when the reference value is 0 Hz, by the motor shaft rotating slowly.

4.

Optimization of current control

With regard to the following optimization and adaptation tips it should be remembered that the overall current is composed of the d- and q-current based on the following relationship:

$$|i| = \sqrt{i_d^2 + i_q^2}$$

As a result the effective value of the apparent current is produced as:

$$I_S = |i| / \sqrt{2}$$

At a maximum device rated current (397-CFPNM) equivalent to the apparent current I_S the d and q current variables are thereby automatically limited.

When the motor is run with rated torque the nominal value of the d-current is less than the nominal value of the q-current. In standard applications which do not demand the rated torque of the motor the q-current is usually smaller than the d-current.

Optimization of the maximum q-current

Optimization of the maximum reference current for current control

When subject to high load surges or heavy load it may be necessary to adjust the maximum reference current. The limitation affects the reference value of the q-current (torque-forming) and finds its upper limit value in the device rated current 397-CFPNM in subject area "_39DD-Device data".

Note: A compromise needs to be found between the formation of a maximum torque and the risk of current overload shut-offs (error E-OC).

Setting CLIMx	Effect
Increase	• Higher torque • Greater tendency to current overload shut-off
Reduce	• Lower torque • Low tendency to current overload shut-off

Table 6.23 Setting of max. reference current for current control

Optimization of the speed controller with the gain SSGFx

5.

With precisely set moments of inertia, Sensorless Flux Control tends toward 20-30 % overshoot when a stepped change of the frequency reference is set. This can be checked with the aid of the DRIVEMANAGER.

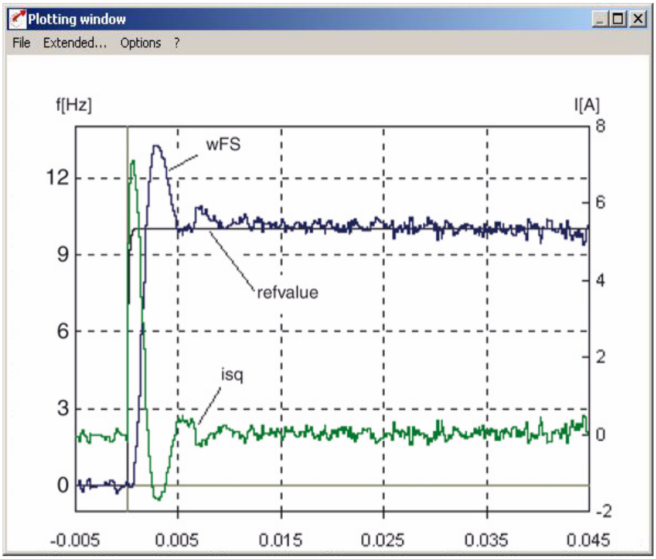
Note: Record step response
The DRIVEMANAGER scope must be used to record the step response. The reference step should only be specified at a low frequency (approx. 10 Hz).

Setting of the scope

Chan-nel	Recording variable	Scope recording variable
0	Reference step	Control reference
1	Step response (actual value)	Output frequency (FOR and SFC)
2	Current i_q (torque)	q-axle current

Table 6.24 Recording variables of the DRIVEMANAGER scope

Attention! The following diagrams illustrate the ideal condition of a system. In actual applications such characteristics are not attainable because of backlash, elasticity or fluctuations in moments.

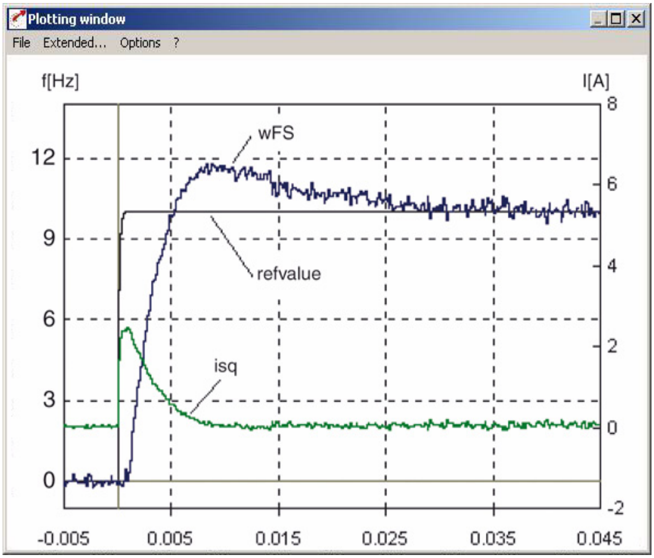


Gain SSGFx too high
→Reduce value for SSFGx

Figure 6.32 Step response of frequency with high overshoot

Abbreviation	Recording variable	User level
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
isq	q-axle current	4

Table 6.25 Recording variables of the plot window

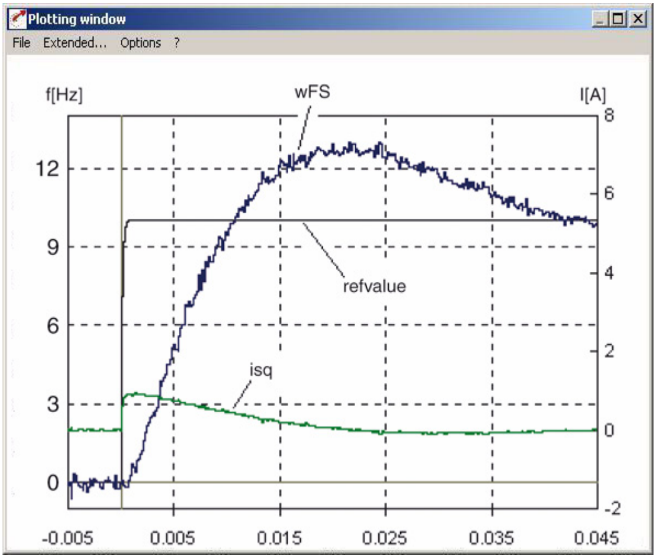


Gain SSGFx optimum (lowest overshoot)
→Do not change value for SSFGx

Figure 6.33 Step response of frequency is optimum

Abbreviation	Recording variable	User level
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
isq	q-axle current	4

Table 6.26 Recording variables of the plot window



Gain SSGFx too low
→ Increase value for SSFGx

Figure 6.34 Step response of frequency with long settling time

Abbreviation	Recording variable	User level
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
isq	q-axle current	4

Table 6.27 Recording variables of the plot window

Tips and setting aids for optimization

Problem	Cause	Remedy
• Implausibly high d-current reference in motors with high power output	The influence of the fault voltages at high inverter outputs (typically > 22 kW) and motors with low stator resistance results in the magnetizing inductance being identified too low.	Reduce switching frequency 690-PMFS to 4 kHz during auto-tuning
• Incorrect number of pole pairs detected	Enter synchronous speed as rated speed or motor with large number of pole pairs (p > 4) and high slip frequency.	Correct rated speed of ASM: • Check rating plate data • Consult motor manufacturer or • estimate a logical value and then restart a new auto-tuning process Enter correct number of pole pairs
• Torque too low because operating point wrong	Imprecise data on motor rating plate	• Check plausibility of rating plate data
• Rated speed not attainable because operating point wrong	Imprecise data on motor rating plate	• Check plausibility of rating plate data

Table 6.28 Optimization aids

6.3 Field-Oriented Regulation (FOR)

Please take note of the general information regarding the properties of the motor control methods in the introduction to section 6 "Control modes".

Note: Field oriented speed control is only suitable for asynchronous motors in standalone operation (not for multi-motor operation!).

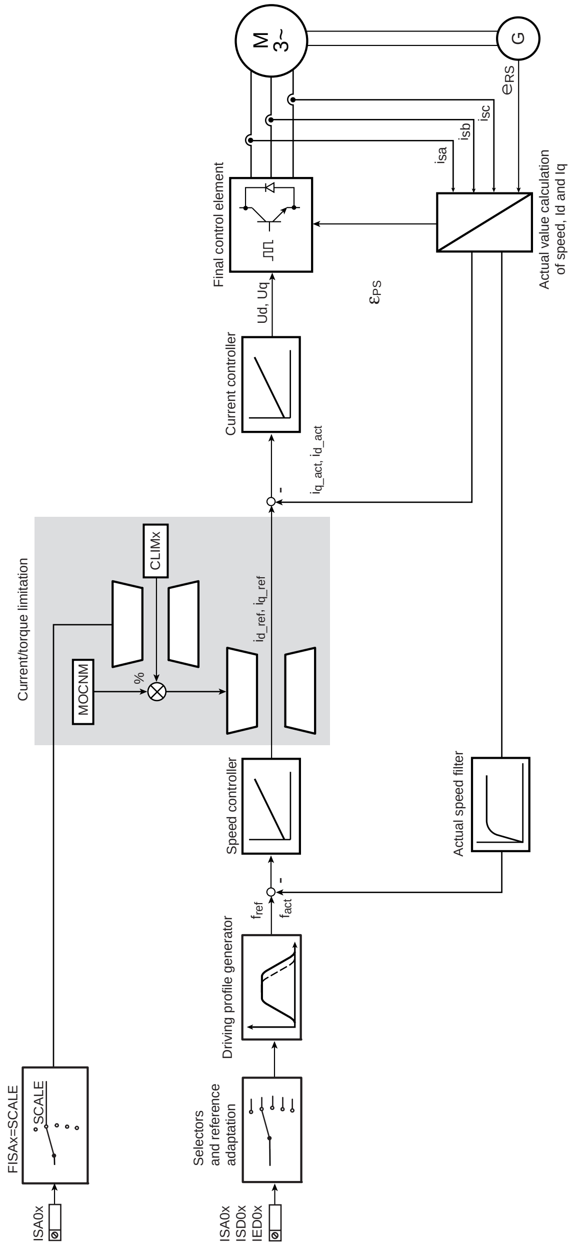


Figure 6.35 Field Oriented Regulation (FOR)

Software functions

In field-oriented speed control (FOR) not all functions of the inverter module are required. The following functions can be selected, but not all actively.

Functions in FOR

Designation	Abbreviation	Active function		Inactive function
		Simultaneous	Subsequent	
Current-controlled startup	_64CA	✔ to V1.40		
DC braking	_67BR		✔	
DC holding	_68H0		✔	
IxR load compensation				✔
Slip compensation	_75SL			✔
Current injection	_76CI			✔
Remagnetization	_77MP	✔		

Table 6.29 Functions in conjunction with FOR

Explanatory notes

- Since setting of FOR mode represents a fully regulated system with speed feedback, the "current-controlled startup" function is not required.
  Consequently, as from firmware V. 2.10, to aid commissioning of field-oriented regulation (FOR) the "current-controlled startup" software function is disabled in the presets of the following application data sets:
  - DRV_4, DRV_5
  - ROT_2, ROT_3
  - M-S_2, M-S_4
- The DC braking and DC holding functions can only be sequenced. If both functions are activated the DC holding function is not activated until the braking time has elapsed. No check that the rotor has come to a standstill is made before activation of the holding time.
- Magnetization can be deactivated by way of parameter 774-MPT=0s in subject area "_77MP-Remagnetization". During autotuning the magnetization time is determined automatically.

Information for auto-tuning

For auto-tuning of the controller and motor parameters the rating plate data of the motor must be entered in the parameter of the " Initial commissioning" subject area (see section 5.1). Precise motor data should be obtained as necessary from the manufacturer.

The operating points of the motor are set based on these data, so precise information from the motor manufacturer is important.

Note: Auto-tuning determines the controller and motor parameters automatically and enters them in the relevant parameters.

In special application cases a further optimization of the parameters based on experimentation with the application may improve the result. Manual optimization is particularly advisable for applications in the limit zone of the electric power rating of the inverter module as well as in case of major load surges, or for special motors. This optimization based on tests should bring the desired success in terms of the drive solution.

Note: During identification the switching frequency of the power stage should be reduced in subject area "_69PM-Modulation" by means of parameter 690-PMFS to 4kHz. This reduction improves the accuracy of motor identification, because the influence of the fault voltages of the inverter power stage is reduced. This measure can improve control response at inverter outputs above 22 kW (from CDA34.045).

6.3.1 _79EN-Encoder evaluation

Function	Effect
• Input of encoder data	• Adaptation of the inverter module to the encoder of the motor

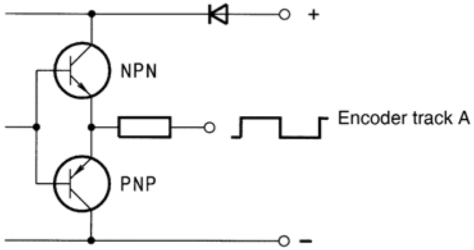
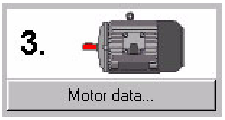


Figure 6.36 HTL output configuration block diagram

Note: In order to maintain the switching times and the edge steepness of the encoder, the cable length dependent on the sampling rate and the supply voltage must not be exceeded. Therefore please refer to the manufacturer's data sheet.

1.

2.



3.

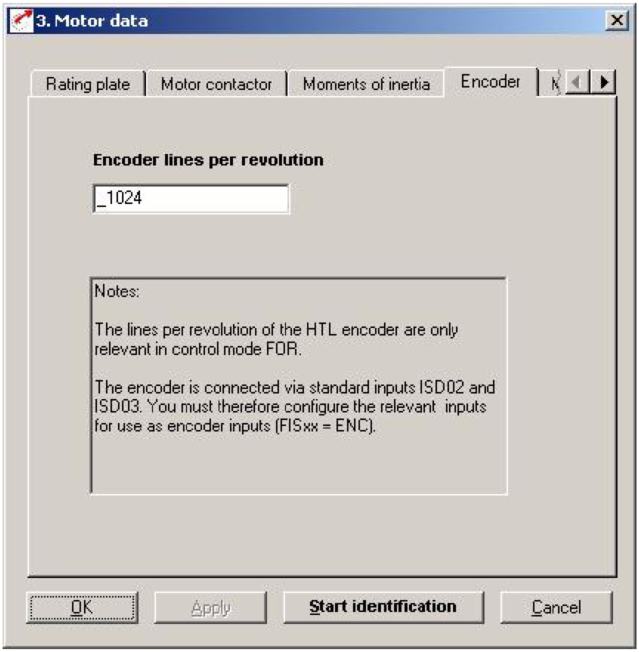


Figure 6.37 Adaptation of the encoder

Parameters of the encoder evaluation subject area

Parameter	Function	Value range	FS	Unit	Online
790-ECLNC	Lines per revolution of encoder	32...16384	1024		
791-MXFLW	Limit value for monitoring of max. frequency deviation in FOR	0 ... 1600	50	Hz	✔

Table 6.30 Parameters from subject area _79EN-Encoder evaluation

Explanatory notes

- On the inverter module the A and B track of a HTL encoder can be evaluated. Differential transducers cannot be evaluated.
- Permissible pulse counts are in the range 2^n with n=5 to 14.
- For speed control the encoder signal in the inverter module is quadrupled, so a good level of speed control is possible with small pulse counts.
- If the maximum frequency deviation is exceeded, error message E-FLW is delivered. The response to the error message can be defined in subject area _51-Error messages.

Only inputs ISD02 and ISD03 can be used for encoder evaluation, see section 5.2.3 "_21ID-Digital inputs".

Minimum reference speed

The minimum reference speed indicates the minimum speed as from which at least one pulse of the encoder per scan cycle of the inverter module can be evaluated.

Formula for calculation of minimum reference speed depending on lines per revolution of encoder:

$$ {}_{min} = \frac{200}{4 \cdot SZ} \cdot 60 \cdot \frac{1}{mi} = \frac{3000}{SZ} \cdot \frac{1}{min} $$

SZ	Lines per revolution
n_{min}	Minimum reference speed in [rpm]

Minimum reference speeds

Encoder lines per revolution pulses per rev	Minimum reference speed rpm	Minimum frequency [Hz]	
		2-pole ASM	4-pole ASM
32	94	1.6	3.3
64	48	0.8	1.6
128	24	0.4	0.8
256	12	0.2	0.4
512	6	0.1	0.2
1024	3	0.05	0.1
2048	1.5	0.03	0.05
4096	0.8	0.02	0.04
8192	0.4	0.01	0.03
16384	0.2	0.01	0.01

Table 6.31 Minimum speeds when using encoders with differing lines per revolution

Maximum reference speed

The maximum reference speed indicates up to what speed the pulses of the encoder can be evaluated by the input of the inverter module.

For specifications of the limit frequency for inputs ISD02 and ISD03 for encoder evaluation refer to section 2.4 "Specification of control connections".

Formula for calculation of maximum reference speed depending on lines per revolution of encoder:

$$n_{max} = \frac{f_{max}[kHz]}{SZ} \cdot 10^{3} \cdot 60\frac{1}{min} = \frac{3000}{SZ} \cdot \frac{1}{min}$$

SZ	Lines per revolution
n_{max}	Maximum reference speed in [rpm]
f_{max}	Limit frequency of inverter input in [kHz]

Typical maximum reference speeds

Encoder lines per revolution pulses per rev	Maximum reference speed [rpm]	Maximum frequency	
		2-pole ASM	4-pole ASM
32	281250	4687 1)	9375 1)
64	140625	2343 1)	4687 1)
128	70312	1171 1)	2343 1)
256	35156	585 1)	1171 1)
512	17578	292 1)	585 1)
1024	8789	146	292 1)
2048	4394	73	146
4096	2198	37	74
8192	1098	18	36
16384	549	9	18

1) Maximum rotating field frequency dependent on inverter type, see table 6.24

Table 6.32 Maximum reference speed when using encoders with differing lines per revolution

The maximum frequency which can be delivered by the inverter is limited by the design size.

Inverter type	Rotating field frequency [Hz]	Switching frequency [kHz]
CDA32.003 (0.375 kW) to CDA34.032 (15 kW)	0 ... 400	4/8/16
CDA34.045 (22 kW) to CDA34.170 (90 kW)	0 ... 200	4/8

Table 6.33 Maximum rotating field frequency of inverter types

6.3.2 _81SC-Speed controller FOR

Function	Effect
• Setting of speed control circuit	• Very smooth running and high drive dynamic

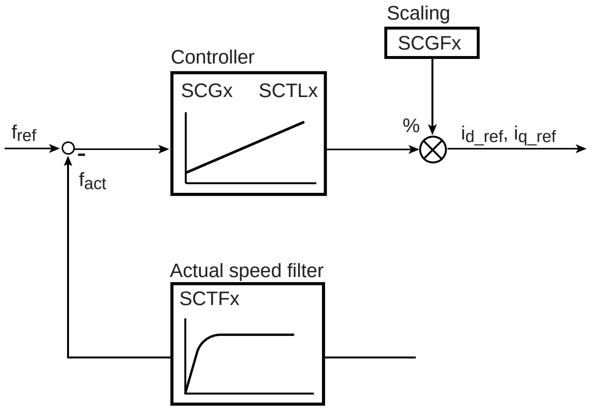
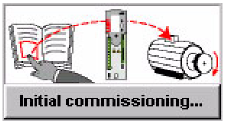
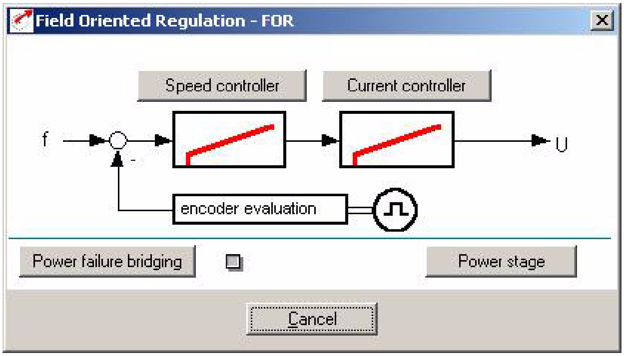


Figure 6.38 FOR speed controller

1.



2.



3.

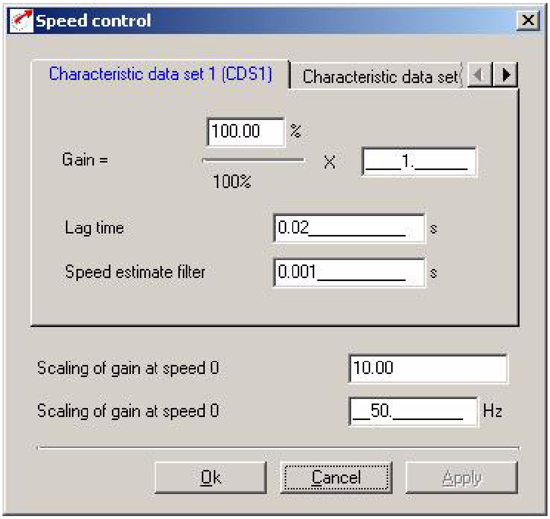


Figure 6.39 Adaptation of the FOR speed controller

Parameters of the speed controller FOR subject area

Parameter	Function	Value range	FS	Unit	Online
810-SCGF1	CDS1: Scaling of speed controller gain	0.00...999.95	100	%	✔
811-SCG1	CDS1: Speed controller gain	0...16383	1		
812-SCTL1	CDS1: Speed controller lag time	0.001...2	0.02	s	
813-SCTF1	CDS1: Jitter filter time constant	0...0.032	0.001	s	
814-SCGF2	CDS2: Scaling of speed controller gain	0.00...999.95	100	%	✔
815-SCG2	CDS2: Speed controller gain	0...16383	1		
816-SCTL2	CDS2: Speed controller lag time	0.001...2	0.02	s	
817-SCTF2	CDS2: Jitter filter time constant	0...0.032	0.001	s	
818-SCGF0	Speed controller gain at frequency zero	0.00...99.95	10	%	

Table 6.34 Parameters from subject area _81SC-Speed controller FOR

Explanatory notes

- All controllers are set by the initial commissioning. With the FOR speed controller the controllers can be fine-tuned as necessary to the special needs of the application.
- The quality of the dimensioning of the speed control circuit is based on exact values for the moments of inertia of the motor and the system. If the value 0 is entered the inverter module enters estimated moments of inertia for the motor and the system (see section 5.1).
- The speed controller gain should be adapted by way of scaling parameter SCGFx according to the application requirements.

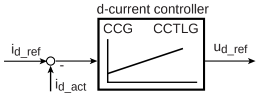
Controller setting	Effect
SCGFx small	• Long rise times, slow control response • Disturbance compensation slow, the controller appears undynamic
SCGFx large	• Short rise times, fast control response • Disturbance compensation fast, the controller appears dynamic • Speed is noisy • High noise

Table 6.35 Response of the encoder

6.3.3 _80CC-Current control

Function	Effect
• Setting of current controller functions	• Optimum parameter setting of PR current controller

Magnetic flux forming current i_d



Torque forming current i_q

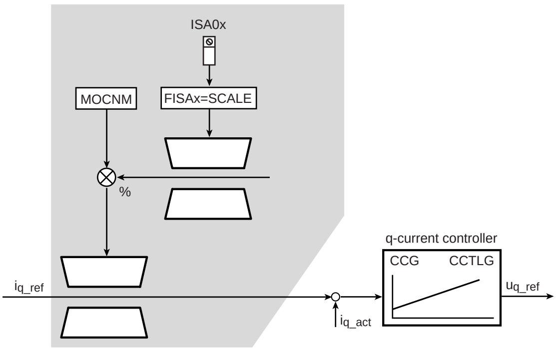
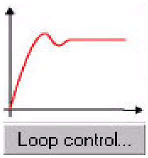
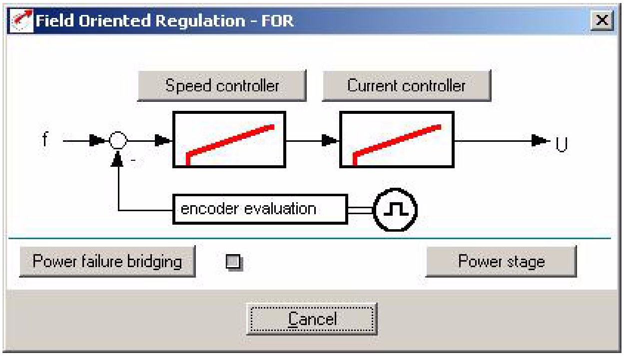


Figure 6.40 FOR current controller



2.



3.

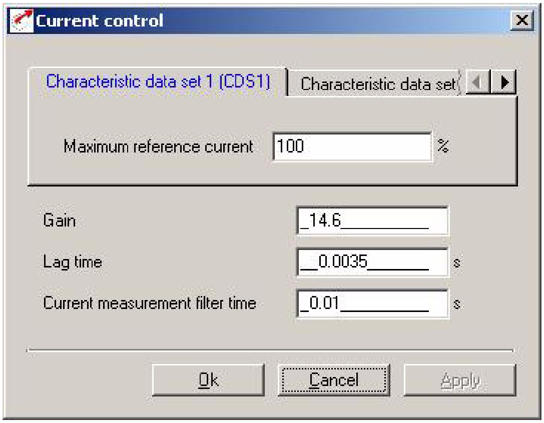


Figure 6.41 Adaptation of the current controller

Parameters of current control

Parameter	Function	Value range	FS	Unit	Online
800-CCG	Current controller gain	0...500	48		
801-CCTLG	Current controller lag time	0.001...100	0.0036	s	
802-CCTF	Filter time constant for current measurement in SFC	0.0005...20	0.01	s	
803-VCSFC	Correction factor of fault voltage characteristic	0...199	70	%	✔

Table 6.36 Parameters of subject area _80CC Current control

Parameter	Function	Value range	FS	Unit	Online
804-CLIM1	CDS1: Maximum reference current for current control	0...180	100	%	
805-CLIM2	CDS2: Maximum reference current for current control	0...180	100	%	

Table 6.36 Parameters of subject area _80CC Current control

Explanatory notes

- No adaptation of the fault voltage compensation is required.
- The parameters of the current controller are set automatically during auto-tuning in initial commissioning. It is not necessary to change the calculated values of the PT controller for the gain (800 -CCG) or the lag time (801-CCTLG).

Additional notes on the other fields of application of the current controller are set out in section 5.5.10.

6.3.4 Tips and optimization aids for control engineers

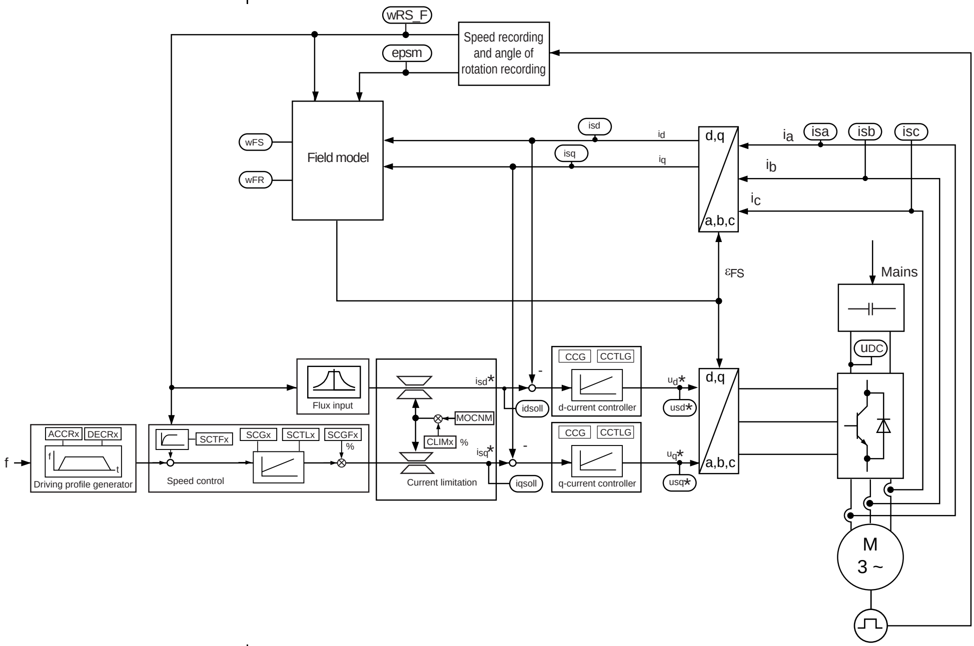
The following section presents tips and optimization aids to deal with typical application errors.

Step	Checks	Help
1	Check that your wiring is connected properly and the phase sequence is correct	see section 2.1 "Device and terminal view"
2	Enter correct (plausible) motor data and start auto-tuning	see section 5.1 "_15FC-Initial commissioning"
3	Check the current control	Optimization of current control in this section
4	Check the speed controller	Optimization of the speed controller in this section

Table 6.37 Procedure for optimization of FOR

Note: The phase currents are measured by hardware in all three phases. In control modes SFC and FOR, to speed up the controller computing time, the phase current of phase W is not calculated in the digital scope of the DRIVEMANAGER.

Structure diagram of FOR



Measuring points of the scope in the DRIVEMANAGER

Parameter

ε_{FS} Stator flux angle

* Reference

Figure 6.42 Structure diagram of field-oriented speed control

Recording variables of the scope function in the DRIVEMANAGER

Recording variable	Abbreviation	User level
d-axle reference current	idref	4
q-axle reference current	iqref	4
d-axle current	isd	4
q-axle current	isq	4
Phase current phase U	isa	1
Phase current phase V	isb	1
Phase current phase W	isc	1
DC-link voltage	udc	1
Slip frequency	wFR	4
Output frequency (FOR)	wFS	3
Rotor frequency (FOR)	wRS_F	1

Table 6.38 Recording variables in the structure diagram of control with FOR (Figure 6.42)

Optimization of current control

3.

With regard to the following optimization and adaptation tips it should be remembered that the overall current is composed of the d- and q-current based on the following relationship:

$$|i| = \sqrt{i_d^2 + i_q^2}$$

As a result the effective value of the apparent current is produced as:

$$I_S = |i| / \sqrt{2}$$

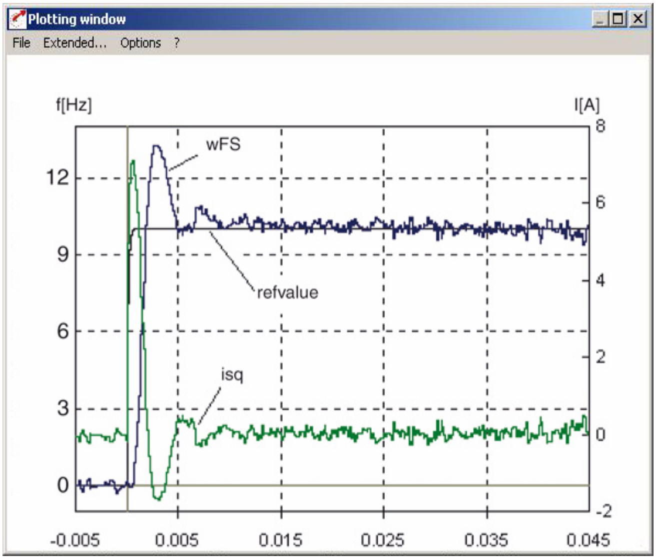
At a maximum device rated current (397-CFPNM) equivalent to the apparent current I_S the d and q current variables are thereby automatically limited.

When the motor is run with rated torque the nominal value of the d-current is less than the nominal value of the q-current. In standard applications which do not demand the rated torque of the motor the q-current is usually smaller than the d-current.

4.

Optimization of the speed controller with the gain SSGFx

For Field-Oriented Regulation the encoder is set in exactly the same way as for Sensorless Flux Control.



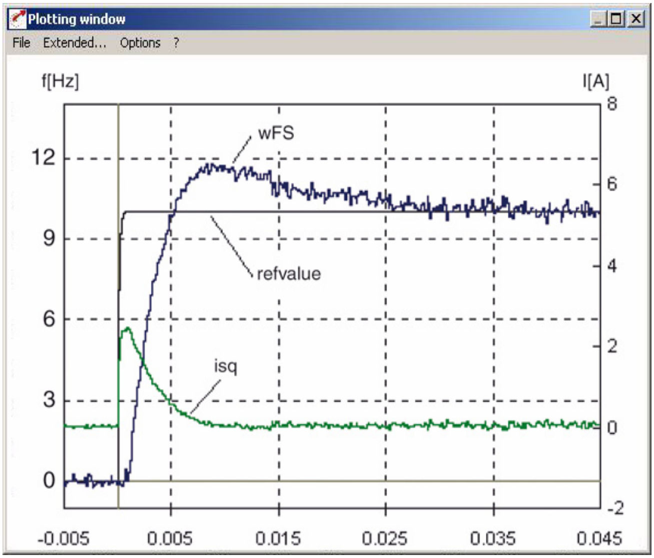
Gain SSGFx too high

Reduce value for SCGFx

Figure 6.43 Step response of frequency with high overshoot

Abbreviation	Recording variable	User level
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
isq	q-axle current	4

Table 6.39 Recording variables of the plot window



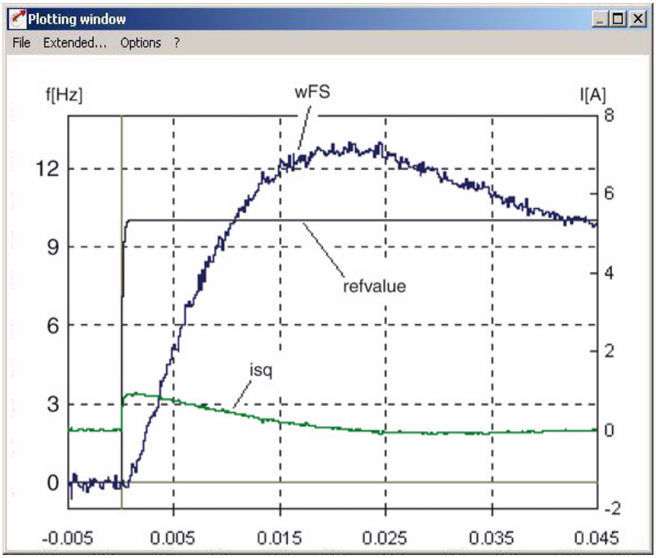
Gain SCGFx too optimal

Do not change value for SCGFx

Figure 6.44 Step response of frequency is optimum

Abbreviation	Recording variable	User level
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
isq	q-axle current	4

Table 6.40 Recording variables of the plot window



Gain SCGFx too small

Increase value for SCGFx

Figure 6.45 Step response of frequency with long settling time

Abbreviation	Recording variable	User level
refvalue	Control reference	1
wFS	Output frequency (FOR and SFC)	3
isq	q-axle current	4

Table 6.41 Recording variables of the plot window

Appendix A Overview of parameters

The following parameter overview contains all the parameters up to user level 01-MODE = 4 in the factory setting (152-ASTER = DRV_1), in software version V1.30-0.

Abbreviations:

R	Read level (LE), indicates the user level (01 - MODE) as from which the parameter is **displayed**.
W	Write level (SE), indicates the user level (01 - MODE) as from which the parameter can be **edited**.
RAM C V	RAM control variable
RAM A V	RAM actual value
FIXPT	Fixed point
FLASH	Flash-EPROM, retained after power-off
G	dependent on device

Note: The DRIVEMANAGER has a user-friendly print function which you can use at any time to print off your latest parameter list.

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
_15FC-Initial commissioning, from Page 5-4									
150	SAVE		Back-up device setup	STOP		2	2	USIGN8	RAM_CV
151	ASTPR		Original application data set	OFF		3	5	USIGN8	FEPROM
152	ASTER		Current application data set (ADS)	DRV_1		1	2	USIGN8	FEPROM
154	MOPNM	kW	Rated motor power	G		1	2	FLOAT32	FEPROM
155	MOVNM	V	Rated motor voltage	G		1	2	FLOAT32	FEPROM
156	MOFN	Hz	Rated motor frequency	50		1	2	FLOAT32	FEPROM
157	MOSNM	rpm	Rated speed	G		1	2	FLOAT32	FEPROM
158	MOCNM	A	Rated motor current	G		1	2	FLOAT32	FEPROM
159	MOCOS		Motor nominal cos-phi	G		1	2	FLOAT32	FEPROM
160	MOJNM	kgmm	Mass moment of inertia of motor	0		3	3	FLOAT32	FEPROM
161	SCJ1	kgmm	CDS 1: Mass moment of inertia of system	0		3	3	FLOAT32	FEPROM
162	SCJ2	kgmm	CDS 2: Mass moment of inertia of system	0		3	3	FLOAT32	FEPROM
163	ENSC		Enable auto-tuning	STOP		2	2	USIGN8	RAM_CV
164	UDSWR		Back-up device setup in a USER data set	1		3	3	USIGN8	RAM_CV
165	UDSAC		Activate USER data set	1		3	3	USIGN8	FEPROM
166	UDSSL		Control location for switchover of the active USER data set	PARAM		3	3	USIGN8	FEPROM
167	SCPRO		Auto-tuning progress indicator	0		2	15	INT8	RAM_AV
300	CFCON		Current open-loop control / closed-loop control mode of the device	VFC		2	2	USIGN8	FEPROM
_18IA-Analog inputs, from Page 5-24									
180	FISA0		Function selector analog standard input ISA00	OFF		1	2	USIGN8	FEPROM
181	FISA1		Function selector analog standard input ISA01	OFF		1	2	USIGN8	FEPROM
182	F0PX1	Hz	CDS 1: Maximum value ISA0 at +10V	50		3	3	INT16	FEPROM
183	F0PN1	Hz	CDS 1: Minimum value ISA0 at +0V	0		3	3	INT16	FEPROM
184	F0NX1	Hz	CDS 1: Maximum value ISA0 at -10V	0		3	3	INT16	FEPROM
185	F0NN1	Hz	CDS 1: Minimum value ISA0 at -0V	0		3	3	INT16	FEPROM
186	F1PX1	Hz	CDS 1: Maximum value ISA1 at +10V	50		3	3	INT16	FEPROM
187	F1PN1	Hz	CDS 1: Minimum value ISA1 at +0V	0		3	3	INT16	FEPROM
188	AFIL0		Filter for analog channel ISA0	3		4	4	USIGN8	FEPROM
189	AFIL1		Filter for analog channel ISA1	3		4	4	USIGN8	FEPROM
190	F0PX2	Hz	CDS 2: Maximum value ISA0 at +10V	50		3	3	INT16	FEPROM
191	F0PN2	Hz	CDS 2: Minimum value ISA0 at +0V	0		3	3	INT16	FEPROM
192	IADB0		ISA0 play range	0.00		4	4	FIXPT16	FEPROM
193	IADB1		ISA1 play range	0.00		4	4	FIXPT16	FEPROM
194	F0NX2	Hz	CDS 2: Maximum value ISA0 at -10V	0		3	3	INT16	FEPROM
195	F0NN2	Hz	CDS 2: Minimum value ISA0 at -0V	0		3	3	INT16	FEPROM
196	F1PX2	Hz	CDS 2: Maximum value ISA1 at +10V	50		3	3	INT16	FEPROM
197	F1PN2	Hz	CDS 2: Minimum value ISA1 at +0V	0		3	3	INT16	FEPROM
_20OA-Analog output, from Page 5-32									
200	FOSA0		Function selector analog output OSA00	AACTF		1	2	USIGN8	FEPROM
201	OAMN0		Minimum value for analog output OSA00	0		3	3	INT16	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
202	OAMX0		Maximum value for analog output OSA00	100		3	3	INT16	FEPROM
203	OAFI0		Filter constant for OSA00	4		3	3	USIGN8	FEPROM
204	TSCL	Nm	Torque (scaling value)	20		3	3	FLOAT32	FEPROM
_21ID-Digital inputs, from Page 5-38									
210	FIS00		Function selector digital standard input ISD00	STR		1	2	USIGN8	FEPROM
211	FIS01		Function selector digital standard input ISD01	STL		1	2	USIGN8	FEPROM
212	FIS02		Function selector digital standard input ISD02	SADD1		1	2	USIGN8	FEPROM
213	FIS03		Function selector digital standard input ISD03	OFF		1	2	USIGN8	FEPROM
214	FIE00		Function selector digital input IED00 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
215	FIE01		Function selector digital input IED01 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
216	FIE02		Function selector digital input IED02 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
217	FIE03		Function selector digital input IED03 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
218	FIE04		Function selector digital input IED04 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
219	FIE05		Function selector digital input IED05 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
220	FIE06		Function selector digital input IED06 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
221	FIE07		Function selector digital input IED07 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
222	FIF0		Function selector virtual fixed input 0	OFF		4	4	USIGN8	FEPROM
223	FIF1		Function selector virtual fixed input 1	OFF		4	4	USIGN8	FEPROM
_240D-Digital outputs, from Page 5-46									
230	REF_R	Hz	Reference-reached window	0.099991		4	4	INT32Q16	FEPROM
240	FOS00		Function selector digital standard output OSD00	BRK1		1	2	USIGN8	FEPROM
241	FOS01		Function selector digital standard output OSD01	REF		1	2	USIGN8	FEPROM
242	FOS02		Function selector digital standard output OSD02 (relay)	S_RDY		1	2	USIGN8	FEPROM
243	FOE00		Function selector digital output OSE00 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
244	FOE01		Function selector digital output OSE01 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
245	FOE02		Function selector digital output OSE02 (terminal expansion)	OFF		3	3	USIGN8	FEPROM
246	FOE03		Function selector digital output OSE03 (terminal expansion)	OFF		3	3	USIGN8	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
247	TENMO	ms	Time between motor contactor and active loop control	300		3	3	USIGN16	FEPROM
_25CK-Clock input/clock output, from Page 5-55									
250	OCLK		Multiplier for clock output OSD01	1X		3	3	USIGN8	FEPROM
251	FFMX1	Hz	CDS 1: Maximum value clock input 10 kHz	50		3	3	INT16	FEPROM
252	FFMN1	Hz	CDS 1: Minimum value clock input 10 kHz	0		3	3	INT16	FEPROM
253	FFMX2	Hz	CDS 2: Maximum value clock input 10 kHz	50		3	3	INT16	FEPROM
254	FFMN2	Hz	CDS 2: Minimum value clock input 10 kHz	0		3	3	INT16	FEPROM
255	INCLF	s	Filter time constant for clock input 10 kHz	0.01		4	4	FLOAT32	FEPROM
_26CL-Control location, from Page 5-71									
7	AUTO		Auto-Start	OFF		4	4	USIGN8	FEPROM
260	CLSEL		Control location selector	TERM		4	4	USIGN8	FEPROM
_27FF-Fixed frequencies, from Page 5-159									
270	FFIX1	Hz	CDS 1: Fixed frequency	20		2	2	INT32Q16	FEPROM
271	FFIX2	Hz	CDS 2: Fixed frequency	20		2	2	INT32Q16	FEPROM
_28RS-Reference structure, from Page 5-61									
280	RSSL1		Reference selector 1	FMAX		4	4	USIGN8	FEPROM
281	RSSL2		Reference selector 2	FCON		4	4	USIGN8	FEPROM
282	FA0	Hz	Analog reference input ISA00	0		4	15	INT32Q16	RAM_AV
283	FA1	Hz	Analog reference input ISA01	0		4	15	INT32Q16	RAM_AV
284	FSIO	Hz	Reference serial interface	0		4	6	INT32Q16	RAM_CV
285	FPOT	Hz	Reference of MOP	0		4	15	INT32Q16	RAM_AV
286	FDIG	Hz	Digital reference input	0		4	15	INT32Q16	RAM_AV
287	FOPT1	Hz	Reference value of option slot 1	0		4	15	INT32Q16	RAM_AV
288	FOPT2	Hz	Reference value of option slot 2	0		4	15	INT32Q16	RAM_AV
289	SADD1		Offset for reference selector 1	10		4	4	USIGN8	FEPROM
290	SADD2		Offset for reference selector 2	0		4	4	USIGN8	FEPROM
291	REF1	Hz	Reference of reference selector 1	0		4	15	INT32Q16	RAM_AV
292	REF2	Hz	Reference of reference selector 2	0		4	15	INT32Q16	RAM_AV
293	REF3	Hz	Reference before limiter	0		4	15	INT32Q16	RAM_AV
294	REF4	Hz	Reference before ramp generator	0		4	15	INT32Q16	RAM_AV
295	REF5	Hz	Reference after ramp generator	0		4	15	INT32Q16	RAM_AV
296	REF6	Hz	Reference for transfer to control	0		4	15	INT32Q16	RAM_AV
297	RF1FA		Factor for reference channel 1	100		4	4	USIGN16	FEPROM
_30OL-Frequency limitation, from Page 5-76									
301	FMIN1	Hz	CDS 1: Minimum frequency	0		2	2	INT32Q16	FEPROM
302	FMIN2	Hz	CDS 2: Minimum frequency	0		2	2	INT32Q16	FEPROM
303	FMAX1	Hz	CDS 1: Maximum frequency	50		2	2	INT32Q16	FEPROM
305	FMAX2	Hz	CDS 2: Maximum frequency	50		2	2	INT32Q16	FEPROM
306	FMXA1	Hz	CDS 1: Absolute limit output frequency	1600		4	4	INT32Q16	FEPROM
307	FMXA2	Hz	CDS 2: Absolute limit output frequency	1600		4	4	INT32Q16	FEPROM
308	DLOCK		Directional lock	OFF		3	3	USIGN8	FEPROM
_31MB-Motor holding brake, from Page 5-139									
310	FBCW	Hz	BRK1: Frequency limit for motor brake (clockwise)	3		3	3	INT32Q16	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
311	FBCCW	Hz	BRK1: Frequency limit for motor brake (anti-clockwise)	-3		3	3	INT32Q16	FEPROM
312	FBHYS	Hz	BRK1: Switch-on hysteresis of motor brake	1		4	4	USIGN16	FEPROM
313	SSCW	Hz	BRK2: Frequency limit for motor brake (clockwise)	3		3	3	INT32Q16	FEPROM
314	SSCCW	Hz	BRK2: Frequency limit for motor brake (anti-clockwise)	3		3	3	INT32Q16	FEPROM
315	SSHYS	Hz	BRK2: Frequency hysteresis for motor brake	0.5		3	3	INT32Q16	FEPROM
316	TREF	ms	BRK2: Delay of acceleration in holding brake function	10		3	3	USIGN16	FEPROM
317	TCTRL	ms	BRK2: Delay of shut-off in holding brake function	G		3	3	USIGN16	FEPROM
_32MP-MOP function, from Page 5-149									
320	MPSEL		Configuration for motor operated potentiometer	OFF		3	3	USIGN8	FEPROM
_33MO-Motor protection, from Page 5-79									
330	MOPTC		Type of PTC evaluation	OFF		2	3	USIGN8	FEPROM
331	MOPCB		2. interpolation point, motor protection characteristic (referred to MOCNM)	100		4	4	USIGN8	FEPROM
332	MOPCA		1. interpolation point, motor protection characteristic (referred to MOCNM)	100		4	4	USIGN8	FEPROM
333	MOPFB	Hz	2. interpolation point, motor protection characteristic	50		4	4	FLOAT32	FEPROM
334	MOTMX		Shut-off temperature (motor)	150		4	4	USIGN16	FEPROM
335	MOPCN	A	Rated motor current for motor protection	06. May		1	2	FLOAT32	FEPROM
336	MOPFN	Hz	Rated motor frequency for motor protection	50		4	4	FLOAT32	FEPROM
_34PF-Power failure bridging, from Page 5-96									
340	PFSEL		Power failure bridging selector	OFF		4	4	USIGN8	FEPROM
341	PFVON	V	DC-link switching threshold for power failure bridging on	260		4	4	INT16	FEPROM
342	PFVRF	V	DC-link reference with DC-link control	236		4	4	INT16	FEPROM
343	PFTIM	ms	Delay in detection of mains power restoration	50		4	4	USIGN16	FEPROM
351	PFC		Power failure bridging effective current reference	100		4	4	USIGN16	FEPROM
354	PFR	Hz/s	Deceleration ramp power failure bridging	999		4	6	INT32Q16	FEPROM
_36KP-KEYPAD, from Page 5-104									
1	MODE		User level of KP200	2		1	1	USIGN8	RAM_CV
13	UAPSP		Parameter list of user definable subject area (11_UA)	0		4	4	USIGN16	FEPROM
360	DISP		Parameter for continuous actual value display of KP200	406		2	2	USIGN16	FEPROM
361	BARG		Parameter for bar graph display of KP200	419		2	2	USIGN16	FEPROM
362	PSW2		Password for user level 2 of KP200	0		2	2	USIGN16	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
363	PSW3		Password for user level 3 of KP200	0		3	3	USIGN16	FEPROM
364	PSW4		Password for user level 4 of KP200	0		4	4	USIGN16	FEPROM
367	PSWCT		Password for Control menu of KP200	0		3	3	USIGN16	FEPROM
368	PNUM		Parameter number display of KP200 on/off	ON		4	4	USIGN8	FEPROM
369	CTLFA		Multiplier of incremental value in CTRL menu (KP200)	10000		4	4	USIGN16	FEPROM
_38TX-Device capacity utilization, from Page 5-112									
380	CACMX		Max. current in acceleration phase of device rated current	0		4	7	USIGN8	FEPROM
381	CDCMX		Max. current in braking phase of device rated current	0		4	7	USIGN8	FEPROM
382	CSTMX		Max. current in stationary operation of device rated current	0		4	7	USIGN8	FEPROM
384	CSCLR		Reset peak value storage	ACTIVE		4	4	USIGN8	RAM_CV
388	CMID		Mean device capacity utilization	0		4	15	USIGN8	RAM_AV
389	CMIDF	s	Filter time constant for mean device capacity utilization	20		4	4	FLOAT32	FEPROM
435	CMIS		Mean device capacity utilization in stat. operation	0		4	15	USIGN8	RAM_AV
436	CMISF	ms	Filter time constant for device capacity utilization in stat. operation	1000		4	4	FLOAT32	FEPROM
_39DD-Device data, from Page 5-117									
89	NAMDS		Designation of parameter setting (max. 28 characters)			1	2	STRING	FEPROM
90	SREV		Base standard version of modified software	3.20		4	7	FIXPT16	RAM_CV
91	TYPE1		ID number of device type	3404		6	7	USIGN16	FEPROM
92	REV		Software version	3.20		1	7	FIXPT16	FEPROM
93	COMP		Compatibility class of SmartCard	1		6	7	USIGN8	FEPROM
106	CRIDX		Revision index as suffix to version number	99		4	7	USIGN8	RAM_CV
115	CSXOR		Checksum (XOR gate) of program memory	0000H		5	7	USIGN16	RAM_AV
116	CSADD		Checksum (add gate) of program memory	0000H		5	7	USIGN16	RAM_AV
127	S_NR		Serial number of device			3	7	STRING	FEPROM
130	NAME		Symbolic device name			1	6	STRING	FEPROM
390	TYPE		Device type	30000		1	15	USIGN16	RAM_AV
392	CFHSW		Hardware status word of system	0000H		5	15	USIGN16	RAM_AV
394	A_NR		Article number of device			3	7	STRING	FEPROM
395	TSTID		Device test data: Date and sign of tester			5	7	STRING	FEPROM
396	TSTDC		Device test data: Documentation of test sequence	0000111 1H		5	7	USIGN32	FEPROM
397	CFPNM	A	Device rated current	0		4	7	FLOAT32	RAM_AV
_50WA-Warning messages, from Page 5-123									
89	NAMDS		Designation of parameter setting (max. 28 characters)			1	2	STRING	FEPROM
90	SREV		Base standard version of modified software	Mrz 20		4	7	FIXPT16	RAM_CV
92	REV		Software version	Mrz 20		1	7	FIXPT16	FEPROM
106	CRIDX		Revision index as suffix to version number	0		4	7	USIGN8	RAM_CV

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
127	S_NR		Serial number of device	G		3	7	STRING	FEPROM
130	NAME		Symbolic device name			1	6	STRING	FEPROM
390	TYPE		Device type	30000		1	15	USIGN16	RAM_AV
394	A_NR		Article number of device	G		3	7	STRING	FEPROM
397	CFPNM	A	Device rated current	G		4	7	FLOAT32	RAM_AV
_51ER-Error messages, from Page 5-127									
74	ERES		Reset device errors	STOP		4	4	USIGN8	RAM_CV
94	TERR	min	System time on occurrence of last error	0		1	7	USIGN16	RAM_AV
95	ERR1		Last error	- 0.0h		1	7	ERR_STRUC	FEPROM
96	ERR2		Second-last error	- 0.0h		2	7	ERR_STRUC	FEPROM
97	ERR3		Third-last error	- 0.0h		2	7	ERR_STRUC	FEPROM
98	ERR4		Fourth-last error	- 0.0h		2	7	ERR_STRUC	FEPROM
140	R-RNM		Response to error in setting of an operation mode	RESET		4	4	USIGN8	FEPROM
510	R-SIO		Response to SIO watchdog	STOP		4	4	USIGN8	FEPROM
511	R-CPU		Response to CPU error	RESET		4	4	USIGN8	FEPROM
512	R-OFF		Response to undervoltage	STOP		4	4	USIGN8	FEPROM
513	R-OC		Response to current overload	LOCK		4	4	USIGN8	FEPROM
514	R-OV		Response to overvoltage	LOCK		4	4	USIGN8	FEPROM
515	R-OLI		Response to controller I*I*t shut-off	LOCK		4	4	USIGN8	FEPROM
516	R-OTM		Response to motor overheating	LOCK		4	4	USIGN8	FEPROM
517	R-OTI		Response to controller overheating	LOCK		4	4	USIGN8	FEPROM
518	R-SC		Response to error during initial commissioning	LOCK		4	4	USIGN8	FEPROM
519	R-OLM		Response to motor I*t shut-off	LOCK		4	4	USIGN8	FEPROM
520	R-PLS		Response to software runtime error	RESET		4	4	USIGN8	FEPROM
521	R-PAR		Response to faulty parameter list	LOCK		4	4	USIGN8	FEPROM
522	R-FLT		Response to floating point error	RESET		4	4	USIGN8	FEPROM
523	R-PWR		Response to unknown power pack	RESET		4	4	USIGN8	FEPROM
524	R-EXT		Response to external error message	STOP		4	4	USIGN8	FEPROM
525	R-USR		Response to modified software error message	STOP		4	4	USIGN8	FEPROM
526	R-OP1		Response to error in option module slot 1	STOP		4	4	USIGN8	FEPROM
527	R-OP2		Response to error in option module slot 2	STOP		4	4	USIGN8	FEPROM
529	R-WBK		Response to wire break ISA0 (4..20mA)	STOP		4	4	USIGN8	FEPROM
530	R-EEP		Response to memory error (EEPROM)	RESET		4	4	USIGN8	FEPROM
531	EFSCL		Ground fault detection response threshold scaling	0		4	4	USIGN8	FEPROM
532	R-PF		Response after DC-link buffering	STOP		4	4	USIGN8	FEPROM
533	R-FDG		Response to reference coupling transmission error	STOP		4	4	USIGN8	FEPROM
534	R-LSW		Response to reversed limit switches	LOCK		4	4	USIGN8	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
535	R-PRC		Response to exceeding of max. control deviation (PR)	LOCK		4	4	USIGN8	FEPROM
536	R-FLW		Response to exceeding of max. frequency deviation	LOCK		3	3	USIGN8	FEPROM
543	R-OL5		Response to I*t shut-off below 5 Hz	LOCK		4	4	USIGN8	FEPROM
545	TEOC	ms	Time delay of error message E-OC-1	0		3	3	USIGN16	FEPROM
_55LB-LustBus, from Page 5-133									
81	SBAUD	1/s	LustBus transfer rate	57600		4	4	USIGN8	FEPROM
82	SADDR		LustBus device address	1		4	4	USIGN8	FEPROM
83	SDMMY		LustBus dummy parameter	0		4	4	USIGN8	RAM_CV
84	SWDGT	s	LustBus watchdog time setting	0.00		4	4	FIXPT16	FEPROM
85	SERR		LustBus error status word	00H		4	4	USIGN8	RAM_AV
550	SSTAT		Status word of serial interface	0000H		4	4	USIGN16	RAM_AV
_57OP-Option modules, from Page 5-134									
489	CLBDR		CANlust baud rate	500		3	3	USIGN8	FEPROM
492	CACNF		CANlust control/reference transfer mode	4		3	3	USIGN8	FEPROM
570	CAMOD		Function selection option module CANlust	SLAVE		4	4	USIGN8	FEPROM
571	CLADR		CANlust device address	0		3	3	USIGN8	FEPROM
572	CASTA		CAN bus status word	0000H		3	15	USIGN16	RAM_AV
573	CACTR		CAN bus control word	0000H		3	6	USIGN16	RAM_CV
574	CAWDG	ms	CAN bus watchdog time (0 = OFF)	0		3	3	USIGN8	FEPROM
575	CASCY	ms	Sampling time for status message (ms)	80		3	3	USIGN16	FEPROM
576	OP1RV		Software version option module slot 1	0.00		1	7	FIXPT16	RAM_AV
577	OP2RV		Software version option module slot 2	0.00		1	7	FIXPT16	RAM_AV
578	OPTN2		Assignment of option module slot 2	NONE		1	15	USIGN8	RAM_AV
579	OPTN1		Assignment of option module slot 1	NONE		1	15	USIGN8	RAM_AV
580	COADR		CANopen device address	0		3	3	USIGN8	FEPROM
581	COBDR		CANopen baud rate	500		3	3	USIGN8	FEPROM
582	PBADR		Profibus DP device address	0		3	3	USIGN8	FEPROM
583	IOEXT		States of external I/Os	0000H		2	15	USIGN16	RAM_AV
_59DP-Driving profile generator, from Page 5-153									
590	ACCR1	Hz/s	CDS 1: Acceleration ramp	G		2	2	INT32Q16	FEPROM
591	ACCR2	Hz/s	CDS 2: Acceleration ramp	G		2	2	INT32Q16	FEPROM
592	DECR1	Hz/s	CDS 1: Deceleration ramp	G		2	2	INT32Q16	FEPROM
593	DECR2	Hz/s	CDS 2: Deceleration ramp	G		2	2	INT32Q16	FEPROM
594	STPR1	Hz/s	CDS 1: Stop ramp	G		2	2	INT32Q16	FEPROM
595	STPR2	Hz/s	CDS 2: Stop ramp	G		2	2	INT32Q16	FEPROM
596	JTIME	ms	Smoothing time of S-shaped ramp in ms	0		3	3	USIGN16	FEPROM
597	RF0		Response with reference 0Hz	OFF		4	4	USIGN8	FEPROM
_60TB-Driving sets, from Page 5-161									
298	RFMD		Ramp and reference selection	TB1		2	3	USIGN8	FEPROM
600	FFTB0	Hz	Table frequency 1	5		3	3	INT32Q16	FEPROM
601	FFTB1	Hz	Table frequency 2	10		3	3	INT32Q16	FEPROM
602	FFTB2	Hz	Table frequency 3	15		3	3	INT32Q16	FEPROM
603	FFTB3	Hz	Table frequency 4	20		3	3	INT32Q16	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
604	FFTB4	Hz	Table frequency 5	25		3	3	INT32Q16	FEPROM
605	FFTB5	Hz	Table frequency 6	30		3	3	INT32Q16	FEPROM
606	FFTB6	Hz	Table frequency 7	40		3	3	INT32Q16	FEPROM
607	FFTB7	Hz	Table frequency 8	50		3	3	INT32Q16	FEPROM
608	TACR0	Hz/s	Table acceleration ramp 1	20		3	3	INT32Q16	FEPROM
609	TACR1	Hz/s	Table acceleration ramp 2	20		3	3	INT32Q16	FEPROM
610	TACR2	Hz/s	Table acceleration ramp 3	20		3	3	INT32Q16	FEPROM
611	TACR3	Hz/s	Table acceleration ramp 4	20		3	3	INT32Q16	FEPROM
612	TACR4	Hz/s	Table acceleration ramp 5	20		3	3	INT32Q16	FEPROM
613	TACR5	Hz/s	Table acceleration ramp 6	20		3	3	INT32Q16	FEPROM
614	TACR6	Hz/s	Table acceleration ramp 7	20		3	3	INT32Q16	FEPROM
615	TACR7	Hz/s	Table acceleration ramp 8	20		3	3	INT32Q16	FEPROM
616	TDCR0	Hz/s	Table deceleration ramp 1	20		3	3	INT32Q16	FEPROM
617	TDCR1	Hz/s	Table deceleration ramp 2	20		3	3	INT32Q16	FEPROM
618	TDCR2	Hz/s	Table deceleration ramp 3	20		3	3	INT32Q16	FEPROM
619	TDCR3	Hz/s	Table deceleration ramp 4	20		3	3	INT32Q16	FEPROM
620	TDCR4	Hz/s	Table deceleration ramp 5	20		3	3	INT32Q16	FEPROM
621	TDCR5	Hz/s	Table deceleration ramp 6	20		3	3	INT32Q16	FEPROM
622	TDCR6	Hz/s	Table deceleration ramp 7	20		3	3	INT32Q16	FEPROM
623	TDCR7	Hz/s	Table deceleration ramp 8	20		3	3	INT32Q16	FEPROM
624	TBSEL		Table driving set selection	0		3	15	USIGN8	RAM_AV
_63FS-Up synchronization, from Page 6-30									
630	FSSEL		Search mode for Up synchronization	OFF		3	3	USIGN8	FEPROM
631	FSFMX	Hz	Maximum frequency during searching in Up synchronization	50		2	2	INT32Q16	FEPROM
632	FSRMP	Hz/s	Ramp during searching in Up synchronization	50		2	2	INT32Q16	FEPROM
633	FSCL		Current during searching in Up synchroniza-tion	20		3	3	USIGN16	FEPROM
634	FSOND	s	Demagnetization time in Up synchronization	1		3	3	FLOAT32	FEPROM
635	FSSTD	s	Search delay in Up synchronization	0.2		3	3	FLOAT32	FEPROM
636	FSVFD	s	Transition time to normal mode in Up syn-chronization	1		3	3	FLOAT32	FEPROM
637	FSTF	s	Filter time constant for effective current dur-ing Up synchronization	0.01		3	3	FLOAT32	FEPROM
_64CA-Current-controlled startup, from Page 5-182									
639	CLTF	s	Filter time constant for current-controlled startup/rundown	0.01		3	3	FLOAT32	FEPROM
640	CLSL1		CDS 1: Function selector current-controlled startup	CCWFS		3	3	USIGN8	FEPROM
641	CLCL1		CDS 1: Current limit current-controlled star-tup	100		3	3	USIGN16	FEPROM
642	CLFL1	Hz	CDS 1: Lowering frequency current-control-led startup	6		3	3	FLOAT32	FEPROM
643	CLFR1	Hz	CDS 1: Initial frequency current-controlled startup	6		3	3	FLOAT32	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
644	CLRR1	Hz/s	CDS 1: Lowering ramp current-controlled startup	100		3	3	INT32Q16	FEPROM
645	CLSL2		CDS 2: Function selector current-controlled startup	CCWFS		3	3	USIGN8	FEPROM
646	CLCL2		CDS 2: Current limit current-controlled startup	100		3	3	USIGN16	FEPROM
647	CLFL2	Hz	CDS 2: Lowering frequency current-controlled startup	6		3	3	FLOAT32	FEPROM
648	CLFR2	Hz	CDS 2: Initial frequency current-controlled startup	6		3	3	FLOAT32	FEPROM
649	CLRR2	Hz/s	CDS 2: Lowering ramp current-controlled startup	100		3	3	INT32Q16	FEPROM
_65CS-Characteristic data switchover (CDS), from Page 5-166									
650	CDSAC		Activate characteristic data set (CDS)	CDS1		2	15	USIGN8	RAM_CV
651	CDSSL		Control location for switchover of characteristic data set (CDS)	OFF		2	3	USIGN8	FEPROM
652	FLIM	Hz	Limit frequency for switchover CDS 2	20		2	3	INT32Q16	FEPROM
_66MS-Master/Slave operation, from Page 5-169									
837	MSFCT		Master-Slave coupling factor (FDIG)	1		4	4	INT32Q16	FEPROM
838	MSECT	ms	Error trigger time in case of failure of reference master	0		4	4	USIGN16	FEPROM
_67BR-DC braking, from Page 5-173									
670	BRDC		DC braking on/off	OFF		3	3	USIGN8	FEPROM
671	BRDCC		Braking current for DC braking	80		3	3	USIGN16	FEPROM
672	BRTMX	s	Maximum DC braking time	15		3	3	USIGN16	FEPROM
673	BRTOF	s	Demagnetization time before DC braking	0.25		4	4	FIXPT16	FEPROM
674	BRTMN	ms	Minimum DC braking time	0		3	3	USIGN16	FEPROM
_68HO-DC holding, from Page 5-177									
680	HODCC		DC holding current	60		3	3	USIGN16	FEPROM
681	HODCT	s	DC holding time	0.00		3	3	FIXPT16	FEPROM
_69PM-Modulation, from Page 5-189									
690	PMFS		Switching frequency of power stage	G		4	4	USIGN8	FEPROM
_70VF-V/F characteristic, from Page 6-9									
700	VB1	V	CDS 1: Boost voltage	G		3	3	FLOAT32	FEPROM
701	VN1	V	CDS 1: Rated motor voltage	G		3	3	FLOAT32	FEPROM
702	FN1	Hz	CDS 1: Rated motor frequency	50		3	3	FLOAT32	FEPROM
703	V1-1	V	CDS 1: Voltage buffer value 1	0		4	4	FLOAT32	FEPROM
704	V2-1	V	CDS 1: Voltage buffer value 2	0		4	4	FLOAT32	FEPROM
705	V3-1	V	CDS 1: Voltage buffer value 3	0		4	4	FLOAT32	FEPROM
706	V4-1	V	CDS 1: Voltage buffer value 4	0		4	4	FLOAT32	FEPROM
707	V5-1	V	CDS 1: Voltage buffer value 5	0		4	4	FLOAT32	FEPROM
708	V6-1	V	CDS 1: Voltage buffer value 6	0		4	4	FLOAT32	FEPROM
709	F1-1	Hz	CDS 1: Frequency buffer value 1	0		4	4	FLOAT32	FEPROM
710	F2-1	Hz	CDS 1: Frequency buffer value 2	0		4	4	FLOAT32	FEPROM
711	F3-1	Hz	CDS 1: Frequency buffer value 3	0		4	4	FLOAT32	FEPROM
712	F4-1	Hz	CDS 1: Frequency buffer value 4	0		4	4	FLOAT32	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
713	F5-1	Hz	CDS 1: Frequency buffer value 5	0		4	4	FLOAT32	FEPROM
714	F6-1	Hz	CDS 1: Frequency buffer value 6	0		4	4	FLOAT32	FEPROM
715	VB2	V	CDS 2: Boost voltage	G		3	3	FLOAT32	FEPROM
716	VN2	V	CDS 2: Rated voltage	G		3	3	FLOAT32	FEPROM
717	FN2	Hz	CDS 2: Rated motor frequency	50		3	3	FLOAT32	FEPROM
718	V1-2	V	CDS 2: Voltage buffer value 1	0		4	4	FLOAT32	FEPROM
719	V2-2	V	CDS 2: Voltage buffer value 2	0		4	4	FLOAT32	FEPROM
720	V3-2	V	CDS 2: Voltage buffer value 3	0		4	4	FLOAT32	FEPROM
721	V4-2	V	CDS 2: Voltage buffer value 4	0		4	4	FLOAT32	FEPROM
722	V5-2	V	CDS 2: Voltage buffer value 5	0		4	4	FLOAT32	FEPROM
723	V6-2	V	CDS 2: Voltage buffer value 6	0		4	4	FLOAT32	FEPROM
724	F1-2	Hz	CDS 2: Frequency buffer value 1	0		4	4	FLOAT32	FEPROM
725	F2-2	Hz	CDS 2: Frequency buffer value 2	0		4	4	FLOAT32	FEPROM
726	F3-2	Hz	CDS 2: Frequency buffer value 3	0		4	4	FLOAT32	FEPROM
727	F4-2	Hz	CDS 2: Frequency buffer value 4	0		4	4	FLOAT32	FEPROM
728	F5-2	Hz	CDS 2: Frequency buffer value 5	0		4	4	FLOAT32	FEPROM
729	F6-2	Hz	CDS 2: Frequency buffer value 6	0		4	4	FLOAT32	FEPROM
730	ASCA1		Assistance parameter for V/F characteristic in CDS 1	OFF		1	2	USIGN8	FEPROM
731	ASCA2		Assistance parameter for V/F characteristic in CDS 2	OFF		1	2	USIGN8	FEPROM
73AP-Anti-oscillation, from Page 6-27									
732	APFL1	Hz	CDS 1: Anti-oscillation initial frequency	4		3	3	FLOAT32	FEPROM
733	APFR1	Hz	CDS 1: Anti-oscillation transition range	2		3	3	FLOAT32	FEPROM
734	APGN1		CDS 1: Anti-oscillation gain	0		3	3	INT16	FEPROM
735	APFL2	Hz	CDS 2: Anti-oscillation initial frequency	4		3	3	FLOAT32	FEPROM
736	APFR2	Hz	CDS 2: Anti-oscillation transition range	2		3	3	FLOAT32	FEPROM
737	APGN2		CDS 2: Anti-oscillation gain	0		3	3	INT16	FEPROM
74IR-IxR load compensation, from Page 6-16									
740	IXR1		CDS 1: I*R load compensation on/off	ON		3	3	USIGN8	FEPROM
741	KIXR1	Ohm	CDS 1: I*R correction factor	G		3	3	FLOAT32	FEPROM
742	IXR2		CDS 2: I*R load compensation on/off	ON		3	3	USIGN8	FEPROM
743	KIXR2	Ohm	CDS 2: I*R correction factor	G		3	3	FLOAT32	FEPROM
744	IXRTF	s	Filter time constant for IxR compensation	0.3		3	3	FLOAT32	FEPROM
755	IXRTV	s				3	3	FLOAT32	FEPROM
75SL-Slip compensation, from Page 6-20									
750	SC1		CDS 1: Slip compensation on/off	OFF		3	3	USIGN8	FEPROM
751	KSC1		CDS1: Slip compensation correction factor	G		3	3	FLOAT32	FEPROM
752	SC2		CDS 2: Slip compensation on/off	OFF		3	3	USIGN8	FEPROM
753	KSC2		CDS2: Slip compensation correction factor	G		3	3	FLOAT32	FEPROM
754	KSCTF	s	Filter time constant for slip compensation	0.01		3	3	FLOAT32	FEPROM
76CI-Current injection, from Page 6-23									
760	CICN1		CDS 1: Current injection reference	120		3	3	USIGN16	FEPROM
761	CIFM1	Hz	CDS 1: Limit frequency of current injection	4		3	3	FLOAT32	FEPROM
762	CIFR1	Hz	CDS 1: Transition range of current injection	2		4	4	FLOAT32	FEPROM

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
763	CICN2		CDS 2: Current injection reference	120		3	3	USIGN16	FEPROM
764	CIFM2	Hz	CDS 2: Limit frequency of current injection	4		3	3	FLOAT32	FEPROM
765	CIFR2	Hz	CDS 2: Transition range of current injection	2		4	4	FLOAT32	FEPROM
766	CITM1	s	CDS1: Current injection timer for switchover to CICT1	6		3	3	FLOAT32	FEPROM
767	CICT1		CDS 1: Reference at end of current injection CITM1	30		3	3	USIGN16	FEPROM
768	CITM2	s	CDS2: Current injection timer for switchover to CICT2		6	3	3	FLOAT32	FEPROM
769	CICT2		CDS 2: Reference at end of current injection CITM2	30		3	3	USIGN16	FEPROM
_77MP-Remagnetization, from Page 5-194									
770	MPCN1		CDS 1: Magnetization current for VFC, SFC and FOR	G		3	3	USIGN16	FEPROM
771	MPT1	s	CDS 1: Magnetization time for VFC	0.00		3	3	FIXPT16	FEPROM
772	MPCN2		CDS 2: Magnetization current for VFC, SFC and FOR	G		3	3	USIGN16	FEPROM
773	MPT2	s	CDS 2: Magnetization time VFC	0.00		3	3	FIXPT16	FEPROM
774	MPT	s	Magnetization time for SFC and FOR	0.50		3	3	FIXPT16	FEPROM
_78SS- Speed controller SFC, from Page 6-47									
780	SSGF1		CDS 1: Scaling of speed controller gain	100.00		3	3	FIXPT16	FEPROM
781	SSG1		CDS1: Speed controller gain	1		3	4	FLOAT32	FEPROM
782	SSTL1	s	CDS 1: Speed controller lag time	G		4	4	FLOAT32	FEPROM
783	SSTF1	s	CDS 1: Filter time constant of speed estimate	0.02		4	4	FLOAT32	FEPROM
784	SSGF2		CDS 2: Scaling of speed controller gain	100.00		3	3	FIXPT16	FEPROM
785	SSG2		CDS 2: Speed controller gain	1		3	4	FLOAT32	FEPROM
786	SSTL2	s	CDS 2: Speed controller lag time	G		4	4	FLOAT32	FEPROM
787	SSTF2	s	CDS 2: Filter time constant of speed estimate	0.02		4	4	FLOAT32	FEPROM
_79EN-Encoder evaluation, from Page 6-69									
790	ECLNC		Lines per revolution of encoder	1024		2	3	USIGN16	FEPROM
791	MXFLW	Hz	Limit value for monitoring of max. frequency deviation in FOR	50		3	3	INT32Q16	FEPROM
_80CC-Current control, from Page 6-78									
800	CCG		Current controller gain	G		4	4	FLOAT32	FEPROM
801	CCTLG	s	Current controller lag time	G		4	4	FLOAT32	FEPROM
802	CCTF	s	Filter time constant for current measurement	0.01		4	4	FLOAT32	FEPROM
803	VCSFC		Correction factor of fault voltage characteristic for SFC	G		4	4	USIGN8	FEPROM
804	CLIM1		CDS 1: Maximum reference current for current control	100		3	3	USIGN16	FEPROM
805	CLIM2		CDS 2: Maximum reference current for current control	100		3	3	USIGN16	FEPROM
_81SC-Speed controller FOR, from Page 6-75									
810	SCGF1		CDS 1: Scaling of speed controller gain	100.00		3	3	FIXPT16	FEPROM
811	SCG1		CDS1: Speed controller gain	1		3	4	FLOAT32	FEPROM
812	SCTL1	s	CDS 1: Speed controller lag time	G		4	4	FLOAT32	FEPROM

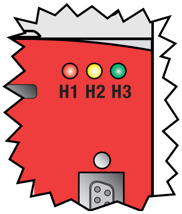
No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
813	SCTF1	s	CDS 1: Jitter filter time constant	0.001		4	4	FLOAT32	FEPROM
814	SCGF2		CDS 2: Scaling of speed controller gain	100.00		3	3	FIXPT16	FEPROM
815	SCG2		CDS 2: Speed controller gain	1		3	4	FLOAT32	FEPROM
816	SCTL2	s	CDS 2: Speed controller lag time	G		4	4	FLOAT32	FEPROM
817	SCTF2	s	CDS 2: Jitter filter time constant	0.001		4	4	FLOAT32	FEPROM
818	SCGF0		Speed controller gain at frequency zero	10.00		3	3	FIXPT16	FEPROM
_82PR-Process controller, from Page 5-198									
820	PRCT1		CDS 1: Process controller on/off	OFF		3	3	USIGN8	FEPROM
821	PRCT2		CDS 2: Process controller on/off	OFF		3	3	USIGN8	FEPROM
822	PRG1		CDS 1: Process controller gain	0		3	3	INT32Q16	FEPROM
823	PRTL1	s	CDS 1: Process controller lag time	0		3	3	INT32Q16	FEPROM
824	PRG2		CDS 2: Process controller gain	0		3	3	INT32Q16	FEPROM
825	PRTL2	s	CDS 2: Process controller lag time	0		3	3	INT32Q16	FEPROM
826	PRMX1	Hz	CDS 1: Process controller limitation	1600		3	3	INT32Q16	FEPROM
827	PRMX2	Hz	CDS 2: Process controller limitation	1600		3	3	INT32Q16	FEPROM
828	PRMCD	Hz	Maximum control deviation of process controller	50		3	3	INT32Q16	FEPROM
829	PRACD	s	Switch-on delay of PR max. control deviation function	5.00		3	3	FIXPT16	FEPROM
_84MD-Motor data, from Page 5-192									
839	MONAM		Symbolic motor name (max. 28 characters)			3	3	STRING	FEPROM
840	MOFNM	Vs	Nominal pole flux	G		4	5	FLOAT32	FEPROM
841	MOL_S	H	Leakage inductance	G		4	5	FLOAT32	FEPROM
842	MOR_S	Ohm	Stator resistance	G		4	5	FLOAT32	FEPROM
843	MOR_R	Ohm	Rotor resistance	G		4	5	FLOAT32	FEPROM
844	MONPP		Number of pole pairs of motor	2		4	5	USIGN8	FEPROM
850	MOL_M	H	Magnetizing inductance from mag. characteristic	G		4	15	FLOAT32	RAM_AV
_86SY-System, from Page 5-196									
4	PROG		Reset device to factory setting	2		4	4	USIGN16	FEPROM
15	PLRDY		Activate control initialization	OFF		4	4	USIGN8	RAM_CV
_36KP-KEYPAD, from Page 5-104									
8	GROUP		Subject area of KP200	_11UA		1	1	USIGN8	RAM_CV
_VAL-Actuals, from Page 5-120									
14	ACTT	Nm	Actual torque	0		1	7	INT32Q16	RAM_AV
86	TSYS	min	System time after power-up in [min].	0		3	15	USIGN16	RAM_AV
87	TOP	h	Operating hours meter	0		3	7	USIGN16	FEPROM
400	ACTF	Hz	Current actual frequency	0		1	15	INT32Q16	RAM_AV
401	ACTN	rpm	Actual speed	0		1	15	INT32Q16	RAM_AV
404	VMOT	V	Output voltage of inverter	0.00		1	15	FIXPT16	RAM_AV
405	DCV	V	DC-link voltage	0.00		1	15	FIXPT16	RAM_AV
406	REFF	Hz	Current reference frequency	0		1	15	INT32Q16	RAM_AV
407	MTEMP		Motor temperature in KTY84 evaluation	0.00		1	15	FIXPT16	RAM_AV
408	APCUR	A	Effective value of apparent current	0.00		1	15	FIXPT16	RAM_AV
409	ACCUR	A	Effective value of effective current	0.00		1	15	FIXPT16	RAM_AV

No.	Name	Unit	Function	Factory set.	Your set.	R	W	Data type	Memory type
413	ACTOP	h	Operating hours of power stage	0		1	7	USIGN16	FEPROM
416	ISA0	V	Filtered input voltage ISA0	0		4	15	INT32Q16	RAM_AV
417	ISA1	V	Filtered input voltage ISA1	0		4	15	INT32Q16	RAM_AV
418	IISA0		Filtered input current ISA00	0		4	15	INT32Q16	RAM_AV
419	IOSTA		States of digital and analog I/Os	0000H		2	15	USIGN16	RAM_AV
420	OSA00	V	Filtered output voltage OSA00	0		4	15	INT32Q16	RAM_AV
422	CNTL		Control word of system	0000H		4	15	USIGN16	RAM_AV
423	ERPAR		Faulty parameter in self-test	0		4	15	USIGN16	RAM_AV
425	DTEMP		Interior temperature	0.00		1	15	FIXPT16	RAM_AV
427	KTEMP		Heat sink temperature	0.00		1	15	FIXPT16	RAM_AV
428	PS	kVA	Apparent power	0		1	15	FLOAT32	RAM_AV
429	PW	kW	Effective power	0		1	15	FLOAT32	RAM_AV
430	PRER	Hz	Process controller: Current control deviation	0		1	15	INT32Q16	RAM_AV

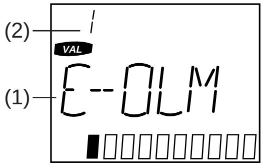
Appendix B Error messages

Errors in operation are signalled as follows:

- CDA3000: Red LED (H1) flashes (flash code see section 2.5 "LEDs")



- DRIVEMANAGER Possible causes of the error and measures to remedy it are displayed in a window.
- KEYPAD KP200: The display is backlit in red and indicates the error (1) and an error location number (2). The error location number provides detailed localization of the cause of the error (see Table A.1).



Acknowledgment and resetting of errors

Errors can be acknowledged and reset in various ways:

- Rising edge at digital input ENPO
- Rising edge at a programmable digital input with setting of the function selector to ERES
- Write value 1 to parameter 74-ERES via control unit or bus system

Response to error

In case of error the inverter module responds with one of the following responses (see Table A.2).

Bus	DM/KP	Function
0	WRN	No response
1	STOP	Disable power stage
2	LOCK	Disable power stage and secure against restarting (prevent auto-start)
3	RESET	Disable power stage and reset device after confirmation of error

Table A.1 Response to error

Error messages

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
0	--	--	No error		
1	E-CPU	1	Error resulting from defective control unit or incorrect software version	Switch device off and back on. (1)	RESET
		8	Error in self-test: Parameter initialization failed because of incorrect parameter description	Switch device off and back on. (1)	
		17	RAM area inadequate for scope functionality.	(1)	
		30	Program memory data faulty. (Self-test on device startup)	(1)	
1	E-CPU	39	Firmware not suitable for device. Program memory data faulty (online program memory permanent).	(1)	
2	E-OFF	1	DC-link voltage too low (also indicated on normal power-off)	Rectify power failure or connect a higher mains voltage	STOP

(1) If this error is repeated please contact your local Service Partner

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
3	E-OC	1	Overcurrent due to: 1. Incorrectly set parameters; 2. Short-circuit, ground-fault or insulation error; 3. Internal device fault	1. Check control circuit parameters; 2. Check installation; 3. (1)	LOCK
		19	Max. current space vector exceeded 1. Incorrectly set parameters; 2. Short-circuit, ground-fault or insulation error; 3. Internal device fault	1. Check control circuit parameters; 2. Check installation; 3. If this error is repeated please contact your local Service Partner.	
		34	Permissible current limit exceeded 1. Incorrectly set parameters; 2. Short-circuit, ground-fault or insulation error; 3. Internal device fault\n\n	1. Check control circuit parameters; 2. Check installation; 3. If this error is repeated please contact your local Service Partner.	
		35	Overcurrent in wiring test	Check wiring in inverter output	
		109	Measuring range overflow of current measurement analog/digital converters: 1. Incorrectly set parameters; 2. Short-circuit, ground-fault or insulation error; 3. Internal device fault	1. Check control circuit parameters; 2. Check installation; 3. If this error is repeated please contact your local Service Partner.	
4	E-OV	1	Overvoltage due to: 1. Overload of the braking chopper (braking too long or too heavy); 2. Mains voltage overload	1. Set DECR ramp parameter slower (_REF), use ext. braking resistor or chopper; 2. Adjust mains voltage	LOCK
5	E-OLM	1	Ixt shut-off to protect motor (permissible current/time area exceeded once/more than once)	1. Reduce load; 2. Use a higher-power motor	LOCK
6	E-OLI	1	I^2xt shut-off to protect power stage (permissible current/time area exceeded once/ more than once)	Reduce load	LOCK
7	E-OTM	18	Motor overheating (PTC in motor tripped) due to: 1. PTC not connected; 2. Motor overload	1. Allow motor to cool; 2. Connect PTC or jumper terminals with 100 Ohm; 3. Use a higher-power motor	LOCK
8	E-OTI	31	Power stage overheating due to: 1. Excessive ambient temperature; 2. Excessive load (power stage or braking chopper)	1. Improve ventilation; 2. Use higher-powered device	LOCK
		32	Overheating in device interior due to: 1. Excessive ambient temperature; 2. Excessive load (power stage or braking chopper)	1. Improve ventilation; 2. Use higher-powered device	

(1) If this error is repeated please contact your local Service Partner

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
9	E-PLS	1	Plausibility check detected invalid parameter or impermissible program sequence	(1)	LOCK
		6	Unknown switching frequency in initialization of power stage protection	(1)	
		8	Parameter list could not be initialized in device startup phase. KP200 may display number of faulty parameter at top left.	Reset device by: 1. Set parameter PROG=1. 2. Switch off device, press and hold down Up and Down key on KP200 and switch device back on. KP200 indicates "RESET"	
		9	Plausibility check detected invalid parameter object (incorrect data type or data length)	(1)	
		10	No readable parameter exists at the current user level or parameter access error via KP200	(1)	
		13	Both slots assigned the same module	Remove one module.	
		20	Error in auto-tuning	1. Check motor rating plate data matches corresponding motor parameters and restart auto-tuning. 2. (1)	
		101	Unknown switching frequency in initialization of PWM	(1)	

(1) If this error is repeated please contact your local Service Partner

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
10	E-PAR	0	Invalid parameter setting	Correct parameter setting or reset device to factory setting	LOCK
		2	Parameter FMINx greater than parameter FMAXx or error in initialization of current-controlled startup	Set FMINx < FMAXx	
		7	The value of a parameter after the device startup phase is outside its value range.	Parameter 423-ERPAR contains the number of the incorrect parameter whose setting needs to be checked.	
		8	Error in first initialization of parameter list. A parameter could not be set to the factory setting.	Parameter 423-ERPAR contains the number of the incorrect parameter whose setting needs to be checked.	
		13	The combination of function selector settings for one of the analog inputs and the reference selector are mutually contradictory	Check and change setting	
		16	The setting of parameter FOSA0 (function selector, output OSA0) is outside its value range	Check and change setting	
		100	Error in controller initialization	Check setting of controller and motor parameters. Restart auto-tuning as necessary.	
		101	Error in initialization of PWM	(1)	
		102	Error in initialization of encoder evaluation	(1)	
		104	Error in initialization of V/F characteristic	(1)	
		105	Error in initialization of actual value recording	(1)	
		106	Two interpolation points of V/F characteristic have same frequency	change setting	
		107	Pitch between two interpolation points for V/F characteristic is too large	change setting	
		108	Error in initialization of SFC resulting from unfavourable parameter settings of motor and controller	Check controller and motor settings and restart auto-tuning as necessary.	
11	E-FLT	0	Global error in floating point calculation	(1)	RESET

(1) If this error is repeated please contact your local Service Partner

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
12	E-PWR	6	Power pack not correctly detected	Send in device	RESET
		8	Error in first initialization of parameter list	1. Send in device; 2. If this error is repeated please contact your local Service Partner	
13	E-EXT	1	Error in an external device	Rectify error in external device	STOP
15	E-OP1	150	Error in module at option slot 1	1. Check module and identifier; 2. (1)	STOP
		151	Error at option 1: BUS-OFF state detected.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		152	Error at option 1: Transmit protocol could not be sent.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		153	Error at option 1: Module not responding	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		154	Error at option 1: Module has signalled error	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		155	Error at option 1: Initialization error	\Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	

(1) If this error is repeated please contact your local Service Partner

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
16	E-OP2	170	Error in module at option slot	1. Check module and identifier 2. If this error is repeated please contact your local Service Partner	STOP
		171	Error at option 2: BUS-OFF state detected.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		172	Error at option 2: Transmit protocol could not be sent.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		173	Error at option 2: Module not responding.	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		174	Error at option 2: Module has signalled error	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	
		175	Error at option 2: Initialization error	Check contacting of module. If the error reoccurs after switching on/off, the device or the module is faulty.	

(1) If this error is repeated please contact your local Service Partner

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
17	E-WRN	0	Device temperature above configured warning threshold	1. Check warning threshold; 2. Improve ventilation; 3. Use higher-powered device	
		1	Interior temperature above configured warning threshold	1. Check warning threshold; 2. Improve ventilation; 3. Use higher-powered device	
		2	Motor temperature above configured warning threshold	1. Check warning threshold; 2. Allow motor to cool; 3. Connect PTC or jumper terminals with 100 Ohm; 4. Use a higher-power motor	
		3	DC link voltage above configured warning threshold for overvoltage	1. Check warning threshold; 2. Set DECR ramp parameter slower (_REF), use ext. braking resistor or chopper; 3. Adjust mains voltage	
		4	DC link voltage below configured warning threshold for undervoltage	1. Check warning threshold; 2. Remedy power failure or connect higher mains voltage	
		5	The output frequency is above the configured warning threshold	1. Check warning threshold; 2. Check settings for reference generation; 3. Adapt reference parameters	
		6	The apparent current is above the configured warning threshold	1. Check warning threshold; 2. Reduce load	
		7	The I^2xt integrator (motor protection) is above the configured warning threshold	1. Check warning threshold; 2. Reduce load; 3. Use a higher-power motor	
		8	Transmission error in reference coupling	1. Check connection	
		9	The Ixt integrator (device protection) has tripped	1. Check warning threshold	
18	E-SIO	11	Watchdog monitoring communication over LustBus tripped	1. Check connection; 2. Check bus master or increase parameter SWDGT	STOP

(1) If this error is repeated please contact your local Service Partner

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
19	E-EEP	3	Error accessing parameter memory	1. Switch device off/on; 2. If this error is repeated please contact your local Service Partner	RESET
		6	Error in hardware initialization	1. Switch device off/on; 2. If this error is repeated please contact your local Service Partner	
		9	Error in initialization of an element function of a parameter object	1. If this error is repeated please contact your local Service Partner.	
		18	Error in initialization of automatic parameter data from EEPROM	1. If this error is repeated please contact your local Service Partner.	
20	E-WBK	1	Possible wire break at input ISA00. Current less than 4mA in parameter setting to 4-20mA	Check wiring of input ISA00	STOP
21	E-SC	20	Error in auto-tuning	1. Check motor wiring and repeat process. 2. If this error is repeated please contact your local Service Partner.	LOCK
		21	Error in auto-tuning. Motor connected or partially disconnected	1. Check motor wiring and repeat process. 2. If this error is repeated please contact your local Service Partner.	
		22	Auto-tuning is suitable only for asynchronous machines.	Set parameter 153-CFMOT to ASM if a relevant motor is being used and repeat auto-tuning.	
		23	Auto-tuning is unable to identify the connected motor correctly.	1. Get motor parameters from manufacturer and enter manually 2. If possible use a different motor	
22	E-PF	1	Error in power failure bridging: The DC-link voltage was not restored within the preset time (parameter 343-PFTIM).	Check mains power supply	STOP
23	E-RM	0	Error in activation of an application data set	1. The error location number identifies the incorrect parameter; 2. (1)	RESET
24	E-FDG	1	Transmission error in reference coupling	Check connection	STOP
25	E-LSW	1	Limit switches reversed	Correct wiring	LOCK
26	E-OL5	1	Ixt shut-off below 5 Hz to protect power stage (exceeding of permissible current/time area)	Reduce load	LOCK

(1) If this error is repeated please contact your local Service Partner

Table A.2 Error messages of the CDA3000

Bus	DM/KP	Error location no.	Error cause	Possible remedy	Response no. in FS
27	E-PRC	1	Exceeding of control deviation (error in control circuit)	Check control circuit	LOCK
28	E-FLW	1	Exceeding of max. frequency deviation in FOR (excessive acceleration/braking)	Reduce ramps	LOCK
(1) If this error is repeated please contact your local Service Partner					

Table A.2 Error messages of the CDA3000

Error messages

If an error occurs during operation it is indicated by a flash code from LED H1 (red) on the inverter module. The code indicates the type of error. If a KP200 is connected the KP200 indicates the error type as an abbreviation.

Flash code of red LED H1	Display KeyPad	Response no.	Explanation	Cause/Remedy
1x	E-CPU	3	Error in CPU (processor)	Switch power off and back on again. If error reoccurs notify LUST Service.
2x	E-OFF	1	Undervoltage shut-off	Check power supply. Also occurs briefly in response to normal power-off.
3x	E-OC	2	Current overload shut-off	Short-circuit, earth fault: check cabling of connections, check motor coil, check neutral conductor and earthing (see also section 3, Installation.) Device setup not correct: check parameters of control circuits. Check ramp setting.
4x	E-OV	2	Voltage overload shut-off	Voltage overload from mains: check mains voltage. Restart device. Voltage overload resulting from feedback from motor (regenerative operation): slow down braking ramps. If not possible, use a braking resistor.
5x	E-OLM	2	Motor protection shut-off	Motor overloaded (after I x t monitoring): slow down process cycle rate if possible. Check motor dimensioning.

Table 5.1 Error messages

Flash code of red LED H1	Display KEYPAD	Response no.	Explanation	Cause/Remedy
6x	E-OLI	2	Device protection shut-off	Device overloaded: check dimensioning. Possibly use a larger device.
7x	E-OTM	2	Motor temperature too high	Motor PTC correctly connected? Parameter MOPTC (type of motor PTC evaluation) correctly set? Motor overloaded? Allow motor to cool down. Check dimensioning.
8x	E-OTI	2	Inverter overheating	Ambient temperature too high: improve ventilation in switch cabinet. Load too high during driving/braking: check dimensioning. Possibly use a braking resistor.

Table 5.1 Error messages

Service Helpline

If you need further assistance, our specialists at the LUST Service Center will be glad to help.

You can reach us:

Mon.-Thur.:	8 a.m. - 4.30 p.m.	Tel. +49 6441/966-180, Fax -177
Fri.:	8 a.m. - 4 p.m.	Tel. +49 6441/966-180, Fax -177
e-mail:	helpline@lust-tec.de	

User errors in KEYPAD operation

Error	Cause	Remedy
ATT1	Parameter cannot be changed at current user level or is not editable.	Select user level 1-MODE higher.
ATT2	Motor must not be controlled via the CTRL menu.	Cancel start signal from a different control location.
ATT3	Motor must not be controlled via the CTRL menu because of error state.	Reset error.
ATT4	New parameter value impermissible	Change value.
ATT5	New parameter value too high	Reduce value.
ATT6	New parameter value too low	Increase value.
ATT7	Card must not be read in current state.	Reset start signal.
ERROR	Invalid password	Enter correct password.

*Table 5.2 KEYPAD user errors: reset with **Start/Enter***

User errors in SMARTCARD operation

Error	Meaning	Remedy
ERR91	SMARTCARD write-protected	Use different SMART-CARD
ERR92	Error in plausibility check	
ERR93	SMARTCARD not readable, wrong inverter type	
ERR94	SMARTCARD not readable, parameter not compatible	
ERR96	Connection to SMARTCARD broken	
ERR97	SMARTCARD DATA invalid (checksum)	
ERR98	Insufficient memory on SMARTCARD	
ERR99	Selected area not present on SMARTCARD, no parameters transferred to SMARTCARD	

*Table 5.3 SMARTCARD error: reset with **Stop/Return***

Appendix C Glossary

87 Hz characteristic	Expanded manipulating range of the motor for constant torque delivery. A motor with 400 V / 50 Hz in star configuration can be expanded to 87 Hz in delta configuration at this voltage.
Abscissa	(Latin: abscissus = torn off, separated) Horizontal axis in coordinates system
Actual	Return value of the external signal acquisition in loop-controlled systems. In open-loop control systems the value calculated on the basis of preset conditions.
Actuator	Final control element to act on a process (component, e.g. servo motor, solenoid valve, power switch)
Address coding plug	Address coding of a device in a bus system by means of a plug connector. An address in a bus system must be unique within a fixed address range.
ADS	**A**pplication **d**ata **s**et; data sets with preset solutions for typical standardized applications, which also serve as the basis for customizations. A customized application data set can only be saved to one user data set.
Analog/digital ground	The analog and digital grounds are isolated from each other in order to avoid transient currents. The analog ground is connected directly to the inverter module processor. It serves as the reference potential for analog reference input. The digital inputs and outputs are isolated from it.
Apparatus	Under the terms of the EMC Act (EMVG): End product with an autonomous function in a dedicated housing and, where appropriate, interfaces and connections for functional and supply integration into its application environment.

Application data set (ADS)	Factory predefined parameter data set to solve typical applications.
Asynchronous motor	Also termed IEC standard motor, squirrel-cage rotor or cage motor. Three-phase a.c. motor which does not run synchronous with the stator speed. The rotor is composed of several rods which are shorted at the ends by rings. The energy transfer from the stator to the rotor is inductive (without brushes or slip rings). Very robust and low-cost.
Attenuation choke	Choke between the output of the inverter module and the motor, to reduce noise. Noise occurs in the motor due to high-frequency components of the current and voltage of an inverter.
Axial	(Latin: axis) In the direction of the axis
Basic range	Speed range below the rated speed of a three-phase a.c. motor in which the stator voltage and the frequency are changed proportionally.
Baud	Jean **Baud**ot; measurement unit in bps (bits per second) for the speed of data transmission.
Binary signal	Signal of which the information parameter can assume only the value Low or High (0 or 1).
Bootstrap	Mode in which a new software release can be transferred to a device. If there is a software program in the device, the device can be switched to Bootstrap mode without pressing the Bootstrap button.
Braking chopper	If the DC-link voltage of the inverter becomes too high, switches a resistor parallel to the DC-link to convert the energy fed back by the machine into heat.
Burst	Consequence of a limited number of single pulses or an oscillation package of limited duration.
Burst immunity	Resistance to short-time electromagnetic interference signals with steep rising edges
CAN	**C**ontroller **A**rea **N**etwork; serial bus system for automotive engineering and industrial control units with high reliability based on error detection, handling and localization. Hamming distance: 6 (Internet http://www.can-cia.de)
CANLust	(CAN = Controller Area Network); networking concept based on the CAN bus system according to the CiA (CAN in Automation) standards, but with Lust-specific communication identifiers, oriented to the CAL (CAN Application Layer) protocol.

CANopen	(CAN = Controller Area Network); CANopen bus system according to the CiA (CAN in Automation) standards, based on the networking concept of the CAN serial bus system.
CDS	Characteristic data set; subsidiary data set within a user data set of the typical parameters for adaptation of the motor characteristic and of the controller and open-loop control properties.
Characteristic data set (CDS)	A user/application data set contains two characteristic data sets for expanded adaptation to the movement task. A characteristic data set comprises a selection of parameters, but not all the parameters available in the inverter module.
Closed-loop control	The controlled variable is recorded, compared against the reference input variable and adapted accordingly to the reference input variable by means of a mathematical relation. Characteristic is a control loop with feedback of the output variables to the input variables.
Control deviation	Difference between controlled variable and reference input variable. If the deviation is equal to zero, the output variable of the controller remains at its quiescent value.
Control deviation	The negative variance x_w is termed the control deviation x_d. Control deviation $x_d = -x_w = w - x$
Control deviation	The negative control deviation is termed control deviation x_d. $x_d = x_w = x - w$.
DC braking	Feed of a direct current into the motor, causing it to brake. The resultant braking energy is converted directly into heat in the motor. The braking power is lower than when a braking resistor is used on the inverter.
Delta voltage	Effective nominal value of the outer conductor voltage of a three-phase AC system
Device	Under the terms of the EMC Act (EMVG): All electrical and electronic apparatus, systems, units and networks containing electrical and electronic components.
DIN	**D**eutsches **I**nstitut für **N**ormung (German standardization organization, located in Berlin, Internet: http://www.din.de)

DM, **DRIVEMANAGER**	User-friendly **D**rive**M**anager user software for drive systems from Lust. Usable on notebooks and PCs running Win 9x/ME/NT/2000 operating systems.
Driving profile generator	The driving profile generator contains the general ramp generator and the table-supported ramp generator. The ramp generators form a driving profile which is run through to attain the frequency reference.
Driving set	A driving data set contains a frequency reference and an assigned acceleration or deceleration ramp which, when the driving set is selected from a table, is set to attain the frequency reference in the table-supported ramp generator.
Driving set	Characterized by a fixed frequency and associated acceleration and deceleration ramps. A driving set is not the same as a positioning set, which also includes a value for a position.
Dynamic speed accuracy	Speed deviation during the startup or braking process of a speed change. The greatest deviation very often occurs in the transient response in settling to the desired speed.
EMC	**E**lectro**m**agnetic **C**ompatibility
EMC	**E**lectro**m**agnetic **C**ompatibility; capability of the electrical unit to function according to its designated purpose in its electromagnetic surroundings and not impermissibly to influence the environment to which other units also belong. Limit values are laid down in directives (e.g. 89/336/EEC) and standards (e.g. IEC 61000 series).
EMR system	Electronic instrumentation and control system
EMVG	German Act governing the electromagnetic compatibility of devices (Internet download: http://www.regtp.de)
ENPO	**EN**able **PO**wer; non-software-dependent hardware enable of inverter power stage.
ESD	**E**lectrostatic **S**ensitive **D**evices
Exponent	(Latin: exponere = expose) Power of a mathematical expression positioned to the top right of it (base). The exponent indicates how often the base is to be multiplied by itself.
Fast reference coupling	In Master/Slave operation the slave drive is controlled by the master speed-synchronously by way of a digital reference transfer. The transmission ratio can be determined by way of a coupling factor.

FELV	**F**unctional **E**xtra **L**ow **V**oltage; without safe isolation (human being: max. 50V AC, 120V DC)
Field bus	Bus system in the process environment for direct connection of sensors and actuators with their own intelligence. The field bus is used for digital data exchange between the control unit and the sensors and actuators.
Field range, Field weakening range	Speed range above the rated speed of a three-phase a.c. motor in which the stator voltage remains constant and only the frequency is changed.
FIXPT16	16-bit raw value divided by 20, to get decimal places resolution in 0.05 increments
FLOAT32	32-bit number format with floating point. A fixed number of places (bits) is reserved for the digits after the point.
FOR	Field Oriented Regulation, control method in which the rotor speed and current angle of the rotor are ascertained with an encoder. The voltage pointers are placed dependent on the calculated information to form the torque from the current. Very high dynamics and smooth running, also safeguarded against stalling.
Freewheeling diode	Diode to protect electronic components under inductive loads. Inductors (such as relay coils) produce high induced voltages at the moment of shutdown which attempt to maintain the current flow in the circuit and result in the destruction of components.
Function selector	Selector switch for function options
Fundamental	Inverters modulate a quasi-sinusoidal pulse width modulated voltage. The flowing current assumes a sinusoidal characteristic based on the inductance of the motor. According to Fourier, the characteristic results from the addition of several sinusoidal oscillations of differing frequency and amplitude. The fundamental is the sinusoidal oscillation with the frequency of the total signal.
Ground fault	A conductive connection of an outer conductor or insulated centre conductor to ground or grounded components resulting from a fault or from arcing.
Hamming distance, HD	Measure for the transmission integrity of digital signals. It indicates the number of positions at which two information bearing code words differ. The higher the hamming distance, the more reliably are errors detected and not interpreted as new code words.

Harmonic	Inverters modulate a quasi-sinusoidal pulse width modulated voltage. The flowing current assumes a sinusoidal characteristic based on the inductance of the motor. According to Fourier, the characteristic results from the addition of several sinusoidal oscillations of differing frequency and amplitude. Harmonics are oscillations with a frequency of a whole-number multiple of the fundamental.
High-side driver	Semiconductor component which actively outputs a voltage. No voltage is connected to ground, as in open-collector circuits. These drivers are generally monitored for overheating and short-circuit.
HTL encoder	Encoder with HTL square signals as output signals. Typical voltage range 10 to 30 V DC. For detection of speed and direction, at least two 90° phase shifted output signals are required. Their output voltages make HTL encoders suitable for direct connection to PLC-compatible inputs as per IEC1131.
IEC	**I**nternational **E**lectrotechnical **C**ommission, international standardization organization comprising national committees. It implements electrotechnical standards at a global level. (Located in Geneva, Internet: http://www.iec.ch)
Initial commissioning	Quick and easy parameter setting of the inverter module by means of the key basic parameters, based on the factory setting of the CDA3000 inverter module.
INT16	Integer in 16-bit data format
INT32Q16	32-bit number format in which the last 16 bits represent the decimal places; no floating point.
IxR load compensation	By shifting of the load characteristic by a voltage amount Δ dependent on the effective current
Lag time	Abbreviation T_N. Characteristic quantity of a PR controller required in a step response to attain a change of a manipulated variable by means of the I-effect. This I-effect is equal to that created by the P-component.
Leakage current	Current occurring in operation as a result of parasitic capacitances or Y-capacitors fitted in devices between live conductors and the ground potential/grounding lead. For safety reasons the leakage current must not exceed device and country specific limit values.
Line choke	Minimizes network feedback from power converters such as commutation notches and harmonics.

LSB	**L**east **S**ignificant **B**it
Manipulated variable	Output variable of the controlling system and thus the input variable for the controlled system.
Master/Slave	The master element dictates and the slave element follows the instructions of the master.
Motor identification	Automated definition of the electrical parameters of a three-phase a.c. motor.
MSB	**M**ost **S**ignificant **B**it
Network	Under the terms of the EMC Act (EMVG): Grouping of multiple transmission links interconnected at individual points electrically or optically by means of a unit, a system, an apparatus or a component.
Open-loop control	The input variables influence the output variables based on a predefined mathematical relationship. The characteristic feature is a path of action with no feedback of the output variables to the input variables.
Outer conductor	Conductor connected to an external point, e.g. L1, L2, L3
Outer conductor voltage	Voltage between two outer conductors, e.g. U_{12}, U_{23}, U_{31} in a three-phase AC system (see also: Delta voltage).
Parameter	Variable with a fixed value range and a predefined factory setting.
P-controller	**P**roportional controller; each value of the control difference is assigned a specific value of the manipulated variable.
PE	**P**rotective **E**arthing
PELV	**P**rotective **E**xtra **L**ow **V**oltage; without safe isolation and additional safety measures (human being: max. 50V AC, 120V DC)
PR controller	**P**roportional–integral controller; the value of the manipulated variable is proportional to the control difference and to its time integral.
PROFIBUS-DP	**PROFIBUS** for **D**ecentralized **P**eripherals; serial bus system for simple digital input and output modules and for intelligent signal and process data processing units. (Internet http://www.profibus.com)
PTC	**P**ositive **T**emperature **C**oefficient; (thermistor) temperature-dependent resistor which increases in resistance as it heats up.

PWM	**P**ulse **W**idth **M**odulation, to emulate a signal.
Ramp generator	The preset frequency reference is attained by acceleration or deceleration of the drive. The necessary ramps are set in the ramp generator.
RCD	**R**esidual **C**urrent protective **D**evice
Reference	Analog or digital input value with which the system is to be operated. Value of the reference input variable in a given moment under analysis.
Reference input variable	Variable not influenced by the control which is fed into the control circuit from the outside. The output variable of the control follows the reference input variable in mathematical dependency. The current value of the reference input variable is termed the reference.
Reluctance motor	Asynchronous motor which, due to its design, runs asynchronous in the startup phase and which, based on its strong pole formation, declines into synchronism in stationary operation.
Remagnetization	Increase in startup and standstill torque by means of magnetic flux build-up prior to starting of the drive
RS232	**R**ecommended **S**tandard 232; standardized serial interface for **one** terminal device with max. 15 meters cable length.
RS485	**R**ecommended **S**tandard 485; standardized serial interface for max. 240 terminal devices and 1000 meters cable length.
Sampling time	Time for all instructions of the inverter software to be processed.
SELV	**S**afety **E**xtra **L**ow **V**oltage; with electrical isolation of higher-voltage circuits and additional safety measures (human being: max. 50V AC, 120V DC).
SFC	Sensorless Flux Control, control method in which the rotor speed and the current angle of the rotor are determined without encoder by way of the electrical variables. The voltage pointers are placed dependent on the calculated information to form the torque from the current. Good dynamics and smooth running, also high torque formation.
Slip	Determines the rotor frequency f_L of the asynchronous motor. As the load increases the slip s becomes greater and the speed decreases. Slip defined in rpm or as % of field speed n_F

Slip compensation	Compensates for load-dependent speed changes of a drive. As load increases the compensation provides an increase in output voltage and frequency, and reduces output voltage and frequency as the load is relieved.
Smoothing	A driving profile with linear ramps is smoothed by sinusoidal speed ramps. This produces an s-shaped speed profile which results in bucking limitation with increased acceleration and deceleration time. The difference in time between the linear ramp and the sinusoidal ramp is termed the smoothing time JTIME.
Smoothness	Measure for the smooth running of a motor.
Speed control range, speed manipulating range	Ratio of maximum speed (usually rated speed) and minimum speed at which the drive is run stationary. Braking and acceleration processes are not taken into account.
Speed manipulating range	Range in which the motor can always deliver nominal torque M_N.
Standstill torque	Momentum built up by the motor from feed via the inverter module in order to counteract a load-dependent rotation of the rotor from its current position.
Static speed accuracy	Speed deviation in the steady (static) state after completion of startup. In operation with speed control a high-frequency ripple is superimposed on the actual speed.
Subject area	Parameters assembled into parameter groups based on function orientation.
Synchronous motor	Motor with permanent magnet excited rotor which requires no slip to the field speed n_F of the stator in order to build up an electromagnetic force. The field speed of the stator and the rotor speed rotate synchronously.
System	Under the terms of the EMC Act (EMVG): A combination of multiple items of apparatus or, where appropriate, electrical or electronic components developed, configured or produced by the manufacturer such that, when correctly installed, the said components together perform a specific task.
Table-supported ramp generator	The frequency reference drawn from a table; is attained with the assigned acceleration or deceleration ramp of the driving set. The necessary ramps are set in the table-supported ramp generator.

Torque rise time Time which expires after a reference step from 0 Nm to M_N until the actual value of the torque in the motor has reached 95% of the nominal value.

Unit Under the terms of the EMC Act (EMVG): Interconnection of machines, systems or electrical/electronic components at a given location such that the said components together perform a specific task.

Usage categories Indication of the suitability of contactors, auxiliary and motor switches for special operating conditions in direct current (DC) or alternating current (AC) systems. Relays of the inverter module: AC-1 = non-inductive or low-inductance loads

User data set (UDS) Custom parameter data set to solve an application task which cannot be solved by the application data set. Data set adapted by a user.

User level Access level to subject areas and parameter to simplify operability. The higher the user levels, the more subject areas and parameters are visible to the user. User levels may be password protected.

VFC **V**oltage to **F**requency **C**onverter or **V**oltage/**F**requency **C**ontrol

Appendix D Index

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